

SIEMENS

Equipment Manual

SINAMICS

S120

AC drive

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SINAMICS

S120 AC Drive

Manual

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Legal information

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 DANGER
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 WARNING
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indicates that minor personal injury can result if proper precautions are not taken.
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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction

1.1 The SINAMICS converter family

With the SINAMICS converter family, you can solve any individual drive task in the low-voltage, medium-voltage and DC voltage range. From converters to motors and controllers, all Siemens drive components are perfectly matched to each other and can be easily integrated into your existing automation system. With SINAMICS you are prepared for digitization. You benefit from highly efficient engineering with a variety of tools for the entire product development and production process. And you also save space in the control cabinet – thanks to the integrated safety technology.

You can find additional information about SINAMICS at the following address (<http://www.siemens.com/sinamics>).

1.2 General information about SINAMICS documentation

SINAMICS documentation

The SINAMICS documentation is organized in the following categories:

- General documentation/catalogs
- User documentation
- Manufacturer/service documentation

Standard scope

The scope of the functionality described in this document can differ from that of the drive system that is actually supplied.

- Other functions not described in this documentation might be able to be executed in the drive system. However, no claim can be made regarding the availability of these functions when the equipment is first supplied or in the event of service.
- The documentation can also contain descriptions of functions that are not available in a particular product version of the drive system. Please refer to the ordering documentation only for the functionality of the supplied drive system.
- Extensions or changes made by the machine manufacturer must be documented by the machine manufacturer.

For reasons of clarity, this documentation does not contain all of the detailed information on all of the product types, and cannot take into consideration every conceivable type of installation, operation and service/maintenance.

1.3 Usage phases and their documents/tools (as an example)

Target group

This documentation is intended for machine manufacturers, commissioning engineers, and service personnel who use the SINAMICS drive system.

Benefits

This manual provides all of the information, procedures and operator actions required for the particular usage phase.

Siemens MySupport/Documentation

You can find information on how to create your own individual documentation based on Siemens content and adapt it for your own machine documentation at the following address (<https://support.industry.siemens.com/My/ww/en/documentation>).

Additional information

You can find information on the topics below at the following address (<https://support.industry.siemens.com/cs/de/en/view/108993276>):

- Ordering documentation/overview of documentation
- Additional links to download documents
- Using documentation online (find and search in manuals/information)

Questions relating to the technical documentation

Please send any questions about the technical documentation (e.g. suggestions for improvement, corrections) to the following email address (<mailto:docu.motioncontrol@siemens.com>).

FAQs

You can find Frequently Asked Questions under Product Support (<https://support.industry.siemens.com/cs/de/en/ps/faq>).

1.3 Usage phases and their documents/tools (as an example)

Usage phase	Document/tool
Orientation	SINAMICS S Sales Documentation
Planning/configuration	<ul style="list-style-type: none">• SIZER Engineering Tool• Configuration Manuals, Motors

1.3 Usage phases and their documents/tools (as an example)

Usage phase	Document/tool
Deciding/ordering	SINAMICS S120 catalogs <ul style="list-style-type: none"> • SINAMICS S120 and SIMOTICS (Catalog D 21.4) • SINAMICS Converters for Single-Axis Drives and SIMOTICS Motors (Catalog D 31) • SINAMICS Converters for Single-Axis Drives – Built-In Units (D 31.1) • SINAMICS Converters for Single-Axis Drives – Distributed Converters (D 31.2) • SINAMICS S210 Servo Drive System (D 32) • SINUMERIK 840 Equipment for Machine Tools (Catalog NC 62)
Installation/assembly	<ul style="list-style-type: none"> • SINAMICS S120 Equipment Manual for Control Units and Supplementary System Components • SINAMICS S120 Equipment Manual for Booksize Power Units • SINAMICS S120 Equipment Manual for Booksize Power Units C/D Type • SINAMICS S120 Equipment Manual for Chassis Power Units • SINAMICS S120 Equipment Manual for Chassis Power Units, Liquid-cooled • SINAMICS S120 Equipment Manual water-cooled chassis power units for common cooling circuits • SINAMICS S120 Equipment Manual for Chassis Power Units, Air-cooled • SINAMICS S120 Equipment Manual for AC Drives • SINAMICS S120 Equipment Manual Combi • SINAMICS S120M Equipment Manual Distributed Drive Technology • SINAMICS HLA System Manual Hydraulic Drives
Commissioning	<ul style="list-style-type: none"> • Startdrive Commissioning Tool • SINAMICS S120 Getting Started • SINAMICS S120 Commissioning Manual • SINAMICS S120 Function Manual Drive Functions • SINAMICS S120 Safety Integrated Function Manual • SINAMICS S120 Function Manual Communication • SINAMICS S120/S150 List Manual • SINAMICS HLA System Manual Hydraulic Drives
Usage/operation	<ul style="list-style-type: none"> • SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual • SINAMICS HLA System Manual Hydraulic Drives
Maintenance/servicing	<ul style="list-style-type: none"> • SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
References	<ul style="list-style-type: none"> • SINAMICS S120/S150 List Manual

1.4 Where can the various topics be found?

Software		Manual
Alarms	Described in order of ascending numbers	SINAMICS S120/S150 List Manual
Parameters	Described in order of ascending numbers	SINAMICS S120/S150 List Manual
Function block diagrams	Sorted according to topic	SINAMICS S120/S150 List Manual
	Described in order of ascending numbers	
Drive functions		SINAMICS S120 Function Manual Drive Functions
Communication topics		SINAMICS S120 Function Manual Communication ²⁾
Safety Integrated	Basic and Extended Functions	SINAMICS S120 Safety Integrated Function Manual
	Basic Functions	SINAMICS S120 Function Manual Drive Functions
Commissioning	Of a simple SINAMICS S120 drive with STARTER	Getting Started ¹⁾
Commissioning	With STARTER	SINAMICS S120 Commissioning Manual ¹⁾
Commissioning	Of a simple SINAMICS S120 drive with Startdrive	Getting Started ²⁾
Commissioning	With Startdrive	SINAMICS S120 Commissioning Manual ²⁾
Web server		SINAMICS S120 Function Manual Drive Functions

Hardware			Manual
Control Units and expansion components	<ul style="list-style-type: none"> Control Units Option Boards Terminal Modules 	<ul style="list-style-type: none"> HUB Modules VSM10 Encoder system connection 	SINAMICS S120 Equipment Manual for Control Units and Supplementary System Components
Booksize power units	<ul style="list-style-type: none"> Line connection Line Modules Motor Modules 	<ul style="list-style-type: none"> DC link components Braking resistors Control cabinet design 	SINAMICS S120 Equipment Manual for Booksize Power Units
Power units, booksize C/D type format			SINAMICS S120 Equipment Manual for Booksize Power Units C/D Type
Chassis power units			SINAMICS S120 Equipment Manual for Chassis Power Units, air, liquid or water cooled
AC drive components			SINAMICS S120 Equipment Manual for AC Drives
S120 Combi components			SINAMICS S120 Equipment Manual Combi
Diagnostics via LEDs	STARTER		SINAMICS S120 Commissioning Manual ¹⁾
	Startdrive		SINAMICS S120 Commissioning Manual ²⁾
Meaning of the LEDs			Equipment Manuals
High Frequency Drive components			SINAMICS S120 System Manual High Frequency Drives

¹⁾ Up to firmware version 5.1 SP1

²⁾ From firmware version 5.2

1.5 Training and support

Training

At the following address (<http://www.siemens.com/sitrain>), you can find information about SITRAIN (Siemens training on products, systems and solutions for automation and drives).

Technical Support

Country-specific telephone numbers for technical support are provided in the Internet at the following address (<https://support.industry.siemens.com/cs/ww/en/sc>) in the "Contact" area.

1.6 Directives, standards, certificates

Relevant directives and standards

You can obtain an up-to-date list of currently certified components on request from your local Siemens office. If you have any questions relating to certifications that have not yet been completed, please ask your Siemens contact person.

Certificates for download

The certificates can be downloaded from the Internet:

Certificates (<https://support.industry.siemens.com/cs/ww/de/ps/13206/cert>)



EC Declaration of Conformity

You can find the EC Declaration of Conformity for the relevant directives as well as the relevant certificates, prototype test certificates, manufacturers declarations and test certificates for functions relating to functional safety ("Safety Integrated") on the Internet at the following address (<https://support.industry.siemens.com/cs/ww/en/ps/13231/cert>).

The following directives and standards are relevant for SINAMICS S devices:

- **European Low Voltage Directive**

SINAMICS S devices fulfil the requirements stipulated in the Low-Voltage Directive 2014/35/EU, insofar as they are covered by the application area of this directive.

- **European Machinery Directive**

SINAMICS S devices fulfil the requirements stipulated in the Low-Voltage Directive 2006/42/EU, insofar as they are covered by the application area of this directive.

However, the use of the SINAMICS S devices in a typical machine application has been fully assessed for compliance with the main regulations in this directive concerning health and safety.

- **Directive 2011/65/EU**

SINAMICS S devices comply with the requirements of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic devices (RoHS II).

- **European EMC Directive**

SINAMICS S devices comply with the EMC Directive 2014/30/EU.

- **EMC requirements for South Korea**

SINAMICS S devices with the KC marking on the type plate satisfy the EMC requirements for South Korea.

- **Eurasian conformity**

SINAMICS S comply with the requirements of the Russia/Belarus/Kazakhstan customs union (EAC).

- **North American market**

SINAMICS S devices provided with one of the test symbols displayed fulfill the requirements stipulated for the North American market as a component of drive applications.

You can find the relevant certificates on the Internet pages of the certifier (<http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.html>).

- **Specification for semiconductor process equipment voltage drop immunity**

SINAMICS S devices meet the requirements of standard SEMI F47-0706.

- **Australia and New Zealand (RCM formerly C-Tick)**

SINAMICS S devices showing the test symbols fulfill the EMC requirements for Australia and New Zealand.

- **Quality systems**

Siemens AG employs a quality management system that meets the requirements of ISO 9001 and ISO 14001.



Not relevant standards



- **China Compulsory Certification**

SINAMICS S devices do not fall in the area of validity of the China Compulsory Certification (CCC).

EMC limit values in South Korea

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.
For sellers or other users, please bear in mind that this device is an A-grade electromagnetic wave device. This device is intended to be used in areas other than at home.

The EMC limit values to be observed for Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3 of category C2 or the limit value class A, Group 1 to KN11. By implementing appropriate additional measures, the limit values according to category C2 or limit value class A, Group 1, are observed. Further, additional measures may be required, such as using an additional radio interference suppression filter (EMC filter).

The measures for EMC-compliant design of the system are described in detail in this manual respectively in the EMC Installation Guideline Configuration Manual.

The final statement regarding compliance with the standard is given by the respective label attached to the individual unit.

1.7 Additional information

Ensuring reliable operation

The manual describes a desired state which, if maintained, ensures the required level of operational reliability and compliance with EMC limit values.

Should there be any deviation from the requirements in the manual, appropriate actions (e.g. measurements) must be taken to check/prove that the required level of operational reliability and compliance with EMC limit values are ensured.

Spare parts

Spare parts are available on the Internet at the following address (<https://www.automation.siemens.com/sow?sap-language=EN>).

Product maintenance

The components are subject to continuous further development within the scope of product maintenance (improvements to robustness, discontinuations of components, etc).

These further developments are "spare parts-compatible" and do not change the article number.

In the scope of such spare parts-compatible further developments, connector/connection positions are sometimes changed slightly. This does not cause any problems with proper use of the components. Please take this fact into consideration in special installation situations (e.g. allow sufficient clearance for the cable length).

Use of third-party products

This document contains recommendations relating to third-party products. Siemens accepts the fundamental suitability of these third-party products.

You can use equivalent products from other manufacturers.

Siemens does not accept any warranty for the properties of third-party products.

Ground symbols

Table 1- 1 Symbols

Icon	Meaning
	Connection for protective conductor
	Ground (e.g. M 24 V)
	Connection for function potential bonding

Testing the protection against electric shock when using frequency converters

Protection on indirect contact in the motor circuit of a converter and automatic disconnection in case of a fault in accordance with DIN EN 60364-4-41 VDE 0100, part 410 is ensured if the following conditions are met:

- The installation instructions provided in the documentation of the converter have been followed, in particular, regarding
 - Equipotential bonding
 - Conductor cross section
 - Fuse protection
- The valid standards were complied with during installation:
 - DIN EN 50178 VDE 0160
 - DIN EN 60204-1 VDE 0113, part 1
 - DIN EN 60364-5-52 VDE 0100-520
 - DIN EN 60364-5-54 VDE 0100-540
- Continuity of the PE conductor is ensured according to DIN VDE 0100-600 (IEC 60364-6)

Converters of the SINAMICS series meet the requirements defined in DIN EN 60364-4-41 VDE 0100, part 410 and comply with the specified break times.

Background

In the case of a short-circuit with negligible impedance to ground, the converter interrupts the circuit within the shortest time ($\ll 100$ ms). As a consequence, there is very high impedance between the converter DC link and the output (> 1 M Ω) so that the possible voltage as result of the voltage divider with the impedance of the ground connection between the motor and converter is less than 50 VAC or 120 VDC.

1.8 General Data Protection Regulation

Compliance with the General Data Protection Regulation

Siemens respects the principles of data protection, in particular the data minimization rules (privacy by design).

For this product, this means:

The product does not process neither store any person-related data, only technical function data (e.g. time stamps). If the user links these data with other data (e.g. shift plans) or if he stores person-related data on the same data medium (e.g. hard disk), thus personalizing these data, he has to ensure compliance with the applicable data protection stipulations.

Fundamental safety instructions

2.1 General safety instructions



WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules.

Generally, the following six steps apply when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Isolate the drive system from the power supply and take measures to prevent it being switched back on again.
3. Wait until the discharge time specified on the warning labels has elapsed.
4. Check that there is no voltage between any of the power connections, and between any of the power connections and the protective conductor connection.
5. Check whether the existing auxiliary supply circuits are de-energized.
6. Ensure that the motors cannot move.
7. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water. Switch the energy sources to a safe state.
8. Check that the correct drive system is completely locked.

After you have completed the work, restore the operational readiness in the inverse sequence.



WARNING

Risk of electric shock and fire from supply networks with an excessively high impedance

Excessively low short-circuit currents can lead to the protective devices not tripping or tripping too late, and thus causing electric shock or a fire.

- In the case of a conductor-conductor or conductor-ground short-circuit, ensure that the short-circuit current at the point where the inverter is connected to the line supply at least meets the minimum requirements for the response of the protective device used.
- You must use an additional residual-current device (RCD) if a conductor-ground short circuit does not reach the short-circuit current required for the protective device to respond. The required short-circuit current can be too low, especially for TT supply systems.



 WARNING
Risk of electric shock and fire from supply networks with an excessively low impedance
Excessively high short-circuit currents can lead to the protective devices not being able to interrupt these short-circuit currents and being destroyed, and thus causing electric shock or a fire.
<ul style="list-style-type: none">• Ensure that the prospective short-circuit current at the line terminal of the inverter does not exceed the breaking capacity (SCCR or I_{cc}) of the protective device used.



 WARNING
Electric shock if there is no ground connection
For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.
<ul style="list-style-type: none">• Ground the device in compliance with the applicable regulations.



 WARNING
Electric shock due to connection to an unsuitable power supply
When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage. Contact with hazardous voltage can result in severe injury or death.
<ul style="list-style-type: none">• Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV- (Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.



 WARNING
Electric shock due to equipment damage
Improper handling may cause damage to equipment. For damaged devices, hazardous voltages can be present at the enclosure or at exposed components; if touched, this can result in death or severe injury.
<ul style="list-style-type: none">• Ensure compliance with the limit values specified in the technical data during transport, storage and operation.• Do not use any damaged devices.

**! WARNING****Electric shock due to unconnected cable shield**

Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.

- As a minimum, connect cable shields and the conductors of power cables that are not used (e.g. brake cores) at one end at the grounded housing potential.

**! WARNING****Arcing when a plug connection is opened during operation**

Opening a plug connection when a system is operation can result in arcing that may cause serious injury or death.

- Only open plug connections when the equipment is in a voltage-free state, unless it has been explicitly stated that they can be opened in operation.

**! WARNING****Electric shock due to residual charges in power components**

Because of the capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.

- Wait for 5 minutes before you check that the unit really is in a no-voltage condition and start work.

NOTICE**Property damage due to loose power connections**

Insufficient tightening torques or vibration can result in loose power connections. This can result in damage due to fire, device defects or malfunctions.

- Tighten all power connections to the prescribed torque.
- Check all power connections at regular intervals, particularly after equipment has been transported.

 **WARNING**

Spread of fire from built-in devices

In the event of fire outbreak, the enclosures of built-in devices cannot prevent the escape of fire and smoke. This can result in serious personal injury or property damage.

- Install built-in units in a suitable metal cabinet in such a way that personnel are protected against fire and smoke, or take other appropriate measures to protect personnel.
- Ensure that smoke can only escape via controlled and monitored paths.

 **WARNING**

Active implant malfunctions due to electromagnetic fields

Inverters generate electromagnetic fields (EMF) in operation. Electromagnetic fields may interfere with active implants, e.g. pacemakers. People with active implants in the immediate vicinity of an inverter are at risk.

- As the operator of an EMF-emitting installation, assess the individual risks of persons with active implants.
- Observe the data on EMF emission provided in the product documentation.

 **WARNING**

Unexpected movement of machines caused by radio devices or mobile phones

When radio devices or mobile phones with a transmission power > 1 W are used in the immediate vicinity of components, they may cause the equipment to malfunction. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- If you come closer than around 2 m to such components, switch off any radios or mobile phones.
- Use the "SIEMENS Industry Online Support app" only on equipment that has already been switched off.

NOTICE

Damage to motor insulation due to excessive voltages

When operated on systems with grounded line conductor or in the event of a ground fault in the IT system, the motor insulation can be damaged by the higher voltage to ground. If you use motors that have insulation that is not designed for operation with grounded line conductors, you must perform the following measures:

- IT system: Use a ground fault monitor and eliminate the fault as quickly as possible.
- TN or TT systems with grounded line conductor: Use an isolating transformer on the line side.

 **WARNING****Fire due to inadequate ventilation clearances**

Inadequate ventilation clearances can cause overheating of components with subsequent fire and smoke. This can cause severe injury or even death. This can also result in increased downtime and reduced service lives for devices/systems.

- Ensure compliance with the specified minimum clearance as ventilation clearance for the respective component.

NOTICE**Overheating due to inadmissible mounting position**

The device may overheat and therefore be damaged if mounted in an inadmissible position.

- Only operate the device in admissible mounting positions.

 **WARNING****Unrecognized dangers due to missing or illegible warning labels**

Dangers might not be recognized if warning labels are missing or illegible. Unrecognized dangers may cause accidents resulting in serious injury or death.

- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, where necessary in the national language.
- Replace illegible warning labels.

NOTICE**Device damage caused by incorrect voltage/insulation tests**

Incorrect voltage/insulation tests can damage the device.

- Before carrying out a voltage/insulation check of the system/machine, disconnect the devices as all converters and motors have been subject to a high voltage test by the manufacturer, and therefore it is not necessary to perform an additional test within the system/machine.

 **WARNING**

Unexpected movement of machines caused by inactive safety functions

Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death.

- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

Note

Important safety notices for Safety Integrated functions

If you want to use Safety Integrated functions, you must observe the safety notices in the Safety Integrated manuals.

2.2 Equipment damage due to electric fields or electrostatic discharge

Electrostatic sensitive devices (ESD) are individual components, integrated circuits, modules or devices that may be damaged by either electric fields or electrostatic discharge.



NOTICE

Equipment damage due to electric fields or electrostatic discharge

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g. conductive foam rubber or aluminum foil.
- Only touch components, modules and devices when you are grounded by one of the following methods:
 - Wearing an ESD wrist strap
 - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring
- Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).

2.3 Warranty and liability for application examples

Application examples are not binding and do not claim to be complete regarding configuration, equipment or any eventuality which may arise. Application examples do not represent specific customer solutions, but are only intended to provide support for typical tasks.

As the user you yourself are responsible for ensuring that the products described are operated correctly. Application examples do not relieve you of your responsibility for safe handling when using, installing, operating and maintaining the equipment.

2.4 Industrial security

Note

Industrial security

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Products and solutions from Siemens constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the Internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. using firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that can be implemented, please visit:

Industrial security (<https://www.siemens.com/industrialsecurity>)

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they become available, and that only the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed at:

Industrial security (<https://www.siemens.com/industrialsecurity>)

Further information is provided on the Internet:

Industrial Security Configuration Manual
(<https://support.industry.siemens.com/cs/ww/en/view/108862708>)

 **WARNING**

Unsafe operating states resulting from software manipulation

Software manipulations, e.g. viruses, Trojans, or worms, can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Keep the software up to date.
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.
- Make sure that you include all installed products into the holistic industrial security concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.
- On completion of commissioning, check all security-related settings.
- Protect the drive against unauthorized changes by activating the "Know-how protection" converter function.

2.5 Residual risks of power drive systems

When assessing the machine- or system-related risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer or system installer must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example,
 - Hardware and/or software errors in the sensors, control system, actuators, and cables and connections
 - Response times of the control system and of the drive
 - Operation and/or environmental conditions outside the specification
 - Condensation/conductive contamination
 - Parameterization, programming, cabling, and installation errors
 - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
 - External influences/damage
 - X-ray, ionizing radiation and cosmic radiation
2. Unusually high temperatures, including open flames, as well as emissions of light, noise, particles, gases, etc., can occur inside and outside the components under fault conditions caused by, for example:
 - Component failure
 - Software errors
 - Operation and/or environmental conditions outside the specification
 - External influences/damage
3. Hazardous shock voltages caused by, for example:
 - Component failure
 - Influence during electrostatic charging
 - Induction of voltages in moving motors
 - Operation and/or environmental conditions outside the specification
 - Condensation/conductive contamination
 - External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly
6. Influence of network-connected communication systems, e.g. ripple-control transmitters or data communication via the network

For more information about the residual risks of the drive system components, see the relevant sections in the technical user documentation.

System overview

3.1 Field of application

SINAMICS is the family of drives from Siemens designed for machine and plant engineering applications. SINAMICS offers solutions for all drive tasks:

- Simple pump and fan applications in the process industry.
- Complex single drives in centrifuges, presses, extruders, elevators, as well as conveyor and transport systems
- Drive line-ups in textile, plastic film, and paper machines as well as in rolling mill plants.
- High precision servo drives in the manufacture of wind turbines
- Highly dynamic servo drives for machine tools, as well as packaging and printing machines



Figure 3-1 SINAMICS applications

Depending on the application, the SINAMICS range offers the ideal version for any drive task.

- SINAMICS S handles complex drive tasks with synchronous/induction motors and fulfills stringent requirements regarding
 - Dynamics and accuracy
 - The integration of extensive technical functions in the drive control system
- SINAMICS G is designed for standard applications with induction motors. These applications have less stringent requirements regarding the dynamic performance of the motor speed.
- SINAMICS V is designed to address applications where basic drive functions are available quickly and at a favorable cost - and which are easy to handle.

3.2 Platform Concept and Totally Integrated Automation

All SINAMICS versions are based on a platform concept. Joint hardware and software components, as well as standardized tools for design, configuration, and commissioning tasks ensure high-level integration across all components. SINAMICS handles a wide variety of drive tasks with no system gaps. The different SINAMICS versions can be easily combined with each other.

Totally Integrated Automation (TIA) with SINAMICS S120

SINAMICS is one of the core components of TIA alongside SIMATIC, SIMOTION and SINUMERIK. It is thus possible to parameterize, program and commission all components in the automation system via the STARTER commissioning tool using a standardized engineering platform and without any system transitions. The system-wide data management functions ensure consistent data and simplify archiving of the entire plant project.

From V14, the Startdrive commissioning tool is an integral element of the TIA platform.

SINAMICS S120 supports communication via PROFINET and PROFIBUS DP.

Communication via PROFINET

This Ethernet-based bus enables control data to be exchanged at high speed via PROFINET IO with IRT or RT and makes SINAMICS S120 a suitable choice for integration in high-performance multi-axis applications. At the same time, PROFINET also uses standard IT mechanisms (TCP/IP) to transport information, e.g. operating and diagnostic data, to higher-level systems. This makes it easy to integrate into an IT corporate network.

Communication via PROFIBUS DP

This bus provides a high-performance, system-wide and integrated communication network which links all automation components of the automation solution:

- HMI (operator control and monitoring)
- Control
- Drives and I/O



Figure 3-2 SINAMICS as part of the Siemens modular automation system

3.3 Overview, SINAMICS S120 AC Drive

SINAMICS S120 AC Drive is a modular drive system for individual axes and addresses sophisticated drive tasks for an extremely wide range of industrial applications.

Applications include:

- Machine concepts with a central drive (e.g. presses, printing, packaging)
- Modular machine concepts where the machine modules were broken down into single axes
- Single-motor drives that when compared to standard drives have a high accuracy, stability and smooth running requirements in machinery and industrial plant construction
- Single-motor drives for transport applications (conveying, raising, lowering)
- Drives without regenerative feedback into the line supply (wire-drawing, extruding)
- Drive groups with high requirements placed on the availability (when the infeed fails, this may not cause all of the axes to fail)

The combination of a power unit (Power Module) and a Control Unit (CU) or a Control Unit Adapter form a single-motor drive in a compact design for machinery and plant construction.

SIZER, a high-performance engineering tool, makes it easier to choose and determine the optimum drive configuration. The drive can be simply commissioned a user-friendly fashion using the STARTER/Startdrive commissioning tool.

SINAMICS S120 AC Drive is supplemented by a wide range of motors. Whether synchronous or induction, whether rotary or linear motors, all motor types are supported by SINAMICS S120 AC Drive.

3.4 SINAMICS S120 components

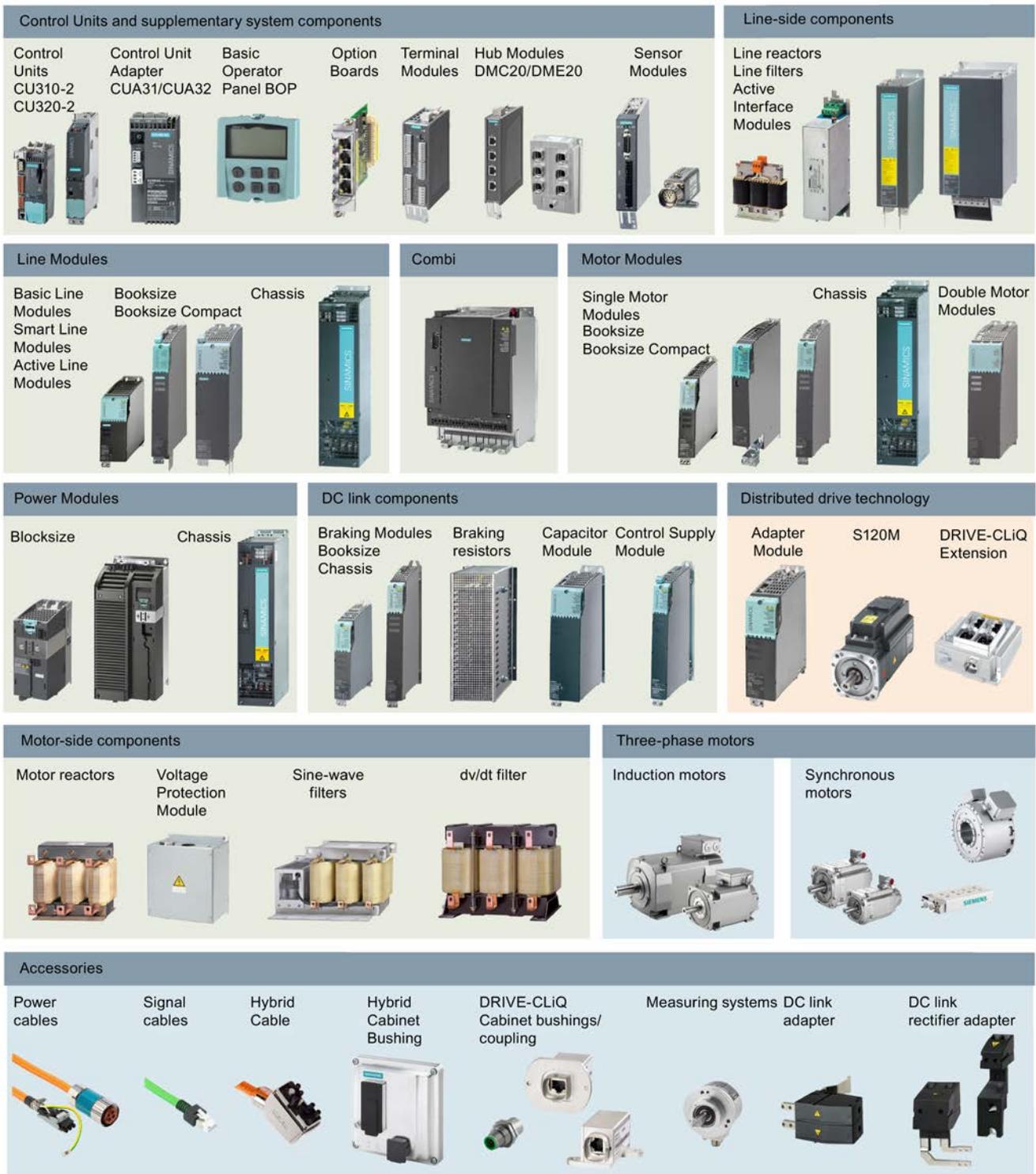


Figure 3-3 Overview of SINAMICS S120 components

The following system components are available for SINAMICS S120 AC Drive:

- Line-side power components, such as fuses, contactors, reactors and line filters for switching the power supply and complying with EMC regulations.
- Power Modules (either with or without integrated line filter) and an integrated braking chopper to provide power to the connected motor

To address the required functions, SINAMICS S120 AC Drive is equipped with:

- Control Units that provide the drive and technological functions
- Additional system components to expand the functionality and to handle various interfaces for encoders and process signals.

The SINAMICS S120 AC Drive components were developed for installation in cabinets.

They have the following features and characteristics:

- Easy to handle, simple installation and wiring
- Practical connection system, cable routing in accordance with EMC requirements
- Uniform design

Note

Installation location in the cabinet

As a general rule, SINAMICS S120 components must be mounted vertically in the control cabinet. If other mounting positions are permissible, these are specified in the descriptions for the individual components.

NOTICE

Overheating of components due to incorrect mounting position

Incorrectly installed components can overheat during operation. Overheating can lead to malfunctions and component damage.
--

- | |
|--|
| <ul style="list-style-type: none">• Only install the components in a permissible mounting position in the control cabinet. |
|--|

3.5 System data

Unless explicitly specified otherwise, the following system data is valid for SINAMICS built-in devices described in this manual.

When engineering the complete S120 drive, the system data of the associated Control Units, supplementary system components, DC link components and sensor modules must be taken into consideration.

3.5.1 System data for PM240-2 Blocksize Power Modules

Table 3- 1 Electrical data for the blocksize format

Line connection voltage Devices FSA to FSC Devices FSD to FSF Device FSG	1 AC: 200 ... 240 V ± 10 % (for Power Modules up to 4 kW) 3 AC: 200 ... 240 V ± 10 % 3 AC: 380 ... 480 V ± 10 % 3 AC: 200 ... 240 V ± 10 % (in operation -20 % < 1 min) 3 AC: 380 ... 480 V ± 10 % (in operation -20 % < 1 min) 3 AC: 500 ... 690 V ± 10 % (in operation -20 % < 1 min) 3 AC: 380 ... 480 V ± 10 % (in operation -20 % < 1 min) 3 AC: 500 ... 690 V ± 10 % (in operation -20 % < 1 min)
Line supply types Power Modules without integrated filter Power Modules with integrated filter	All line supply types TN/TT/IT TN/TT line supplies with grounded neutral point
Line frequency	47 ... 63 Hz
Line power factor for line supply voltage 3 AC and type rating Devices FSA to FSC Devices FSD to FSG	Active factor ($\cos \varphi 1$): > 0.96 power factor (λ): 0.70 ... 0.85 Active factor ($\cos \varphi 1$): 0.98 ... 0.99 power factor (λ): 0.90 ... 0.92
Electromagnetic compatibility Noise immunity noise emission For devices with integrated radio interference suppression filter Standard FSF/FSG devices with 690 V line supply voltage For devices without integrated radio interference suppression filter with optional external radio interference filter for grounded line supplies For devices without integrated radio interference suppression filter for operation on IT line supplies	All PM240-2 Power Modules are suitable for use in the second environment. According to EN 61800-3 Category C2 Category C3 Category C2 Category C4
Overvoltage category	III acc. to EN 61800-5-1
Electronics power supply	Safety extra-low voltage (PELV) acc. to IEC 61800-5-1 Comment: Grounding the 24 V electronics power supply In SINAMICS S120 components, the electronics ground M is permanently connected to the protective conductor potential. ¹⁾
Rated short-circuit current (SCCR) according to UL 61800-5-1	100 kA in conjunction with Class J fuses SCCR in conjunction with other protective devices "Protective devices of for PM240-2 Power Modules (https://support.industry.siemens.com/cs/de/de/view/109486009)".

3.5 System data

Rated pulse frequency For devices with 1/3 AC 200 V rated voltage For devices with 3 AC 400 V rated voltage and a type rating ≤ 90 kW based on I_n and a type rating ≥ 110 kW based on I_n For devices with 3 AC 690 V line voltage	4 kHz 4 kHz 2 kHz 2 kHz
Output voltage	Approx. $0.95 \cdot$ line voltage (maximum value) approx. $0.74 \cdot$ line voltage at 1 AC 200 V
Output frequency	0 ... 550 Hz, dependencies on the control mode and pulse frequency must be taken into account ²⁾

1) When using a motor holding brake, possibly restricted voltage tolerances ($24\text{ V} \pm 10\%$) must be taken into account.

2) Higher output frequencies available on request. In this case, an additional license is required.

Table 3- 2 Degree of protection / protection class

Degree of protection	IP20 acc. to IEC 60529, open type acc. to UL/CSA
Protection class, line supply circuits Electronic circuits	I, with protective conductor connection extra-low-voltage PELV/SELV
Cooling method Internal air cooling External air cooling	Forced air cooling AF acc. to EN 60146 Push Through cooling type

Table 3- 3 Environmental conditions

Chemically active substances	
Long-term storage	Class 1C2 according to EN 60721-3-1, in product packaging ¹⁾
Transport	Class 2C2 according to EN 60721-3-2, in transport packaging ²⁾
Operation	Class 3C2 according to EN 60721-3-3 (for the drive system) Class 3C3 according to EN 60721-3-3 (for the Power Modules)
Biological environmental conditions	
Long-term storage	Class 1B1 according to EN 60721-3-1, in product packaging ¹⁾
Transport	Class 2B1 according to EN 60721-3-2, in transport packaging ²⁾
Operation	Class 3B1 according to EN 60721-3-3
Climatic environmental conditions	
Long-term storage	Class 1K4 according to EN 60721-3-1, in product packaging ¹⁾ Temperature: $-25 \dots +55$ °C Relative humidity: 5 ... 95 %
Transport	Class 2K4 according to EN 60721-3-2, in transport packaging ²⁾ Temperature: $-40 \dots +70$ °C Relative humidity: 5 ... 95 %
Operation	Class 3K3 according to EN 60721-3-3 ³⁾

Ambient temperature ⁴⁾	Without derating	FSA to FSC -10 ... +40 °C for operation with low overload -10 ... +50 °C for operation with high overload (S6 load cycles only to +40 °C)
	With derating	-10 ... +60 °C
	Without derating	FSD to FSG -20 ... +40 °C for operation with low overload -20 ... +50 °C for operation with high overload (S6 load cycles only to +40 °C)
	With derating	-20 ... +60 °C
Relative humidity	5 ... 95 % no condensation Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted	
Degree of pollution	2 according to EN 61800-5-1	
Installation altitude		
Operation	0 ... 1000 m above sea level without derating > 1000 ... 4000 m <ul style="list-style-type: none"> Reduction of the output current by 10 % per 1000 meters, or Reduction in the ambient temperature by 5 °C per 1000 meters > 2000 ... 4000 m above sea level <ul style="list-style-type: none"> Operation on line supply systems with grounded neutral point, or Operation on an isolating transformer with secondary grounded neutral point 	
Mechanical environmental conditions		
Long-term storage	Class 1M2 according to EN 60721-3-1, in product packaging ¹⁾	
Transport	Class 2M3 according to EN 60721-3-2, in transport packaging ²⁾	
Operation	Class 3M1 according to EN 60721-3-3	
Vibration test in operation	According to IEC 60068-2-6 test Fc (sinusoidal) <ul style="list-style-type: none"> 10 ... 57 Hz: 0.075 mm deflection amplitude 57 ... 150 Hz: 1g acceleration amplitude 10 frequency cycles per axis 	
Shock test in operation	According to IEC 60068-2-27 test Ea (half-sine) <ul style="list-style-type: none"> 5 g peak acceleration 30 ms duration 3 shocks in all three axes in both directions 	

1) Product packaging (storage packaging) is individual packaging for storage - and does not satisfy the requirements for transport. As a consequence, product packaging is therefore not suitable for shipping.

2) Transport packaging is either packaging that is directly suitable for transport, or secondary packaging which, together with the product packaging, satisfies the requirements for transport.

3) Increased ruggedness regarding temperature range and relative humidity; therefore better than 3K3

4) Permissible ambient temperatures for Control Units and Control Unit Adapter, see the relevant technical data

Table 3- 4 Certificates

Declarations of Conformity	CE (Low Voltage, EMC and Machinery Directives)
FSA-FSC approvals	cULus acc. to UL 508C/CSA 22.2 No. 274 RCM (C-Tick) SEMI F47 KCC only with internal or external line filters for Category C2 RoHS EAC
Approvals FSD-FSG	cULus acc. to UL 508C/CSA 22.2 No. 274 RCM (C-Tick) SEMI F47 KCC only with internal or external line filters for Category C2 WEEE (Waste Electrical & Electronic Equipment) RoHS EAC

3.5.2 Safety data for Power Modules, chassis format

Table 3- 5 Electrical data

Line connection voltage	3 AC 380 ... 480 V ±10 % (in operation -15 % < 1 min)
Rated pulse frequency	2 kHz
Line system types	TN/TT line supplies or IT line supplies
Line frequency	47 ... 63 Hz
Radio interference suppression	According to EN 61800-3
Output voltage	Approx. 0.95 • line voltage (maximum value) ¹⁾
Electronics power supply	Safety extra-low voltage (PELV) acc. to IEC 61800-5-1 Comment: Grounding the 24 V electronics power supply In SINAMICS S120 components, the electronics ground M is permanently connected to the protective conductor potential. ²⁾
Short-circuit current rating SCCR according to UL508C (up to 600 V)	1.1 ... 447 kW: 65 kA UL certification applies only in conjunction with the fuses prescribed by Siemens and not with other types or circuit breakers alone.
Overvoltage category	III to EN 61800-5-1
Degree of pollution	2 according to EN 61800-5-1

1) 100 % output voltage only possible with modulation type "edge modulation" (FLM).

2) When using a motor holding brake, possibly restricted voltage tolerances (24 V ±10 %) must be taken into account.

Table 3- 6 Degree of protection / protection class

Degree of protection	IP20 acc. to IEC 60529, open type acc. to UL/CSA
Protection class, line supply circuits Electronic circuits	I (with protective conductor connection) according to EN 61800-5-1 protective extra low-voltage (PELV/SELV)

Table 3- 7 Environmental conditions

Chemically active substances	
Long-term storage ¹⁾	Class 1C2 according to EN 60721-3-1
Transport ¹⁾	Class 2C2 according to EN 60721-3-2
Operation	Class 3C2 according to EN 60721-3-3
Biological environmental conditions	
Long-term storage ¹⁾	Class 1B1 according to EN 60721-3-1
Transport ¹⁾	Class 2B1 according to EN 60721-3-2
Operation	Class 3B1 according to EN 60721-3-3
Climatic environmental conditions	
Long-term storage ¹⁾	Class 1K4 according to EN 60721-3-1 Temperature: -25 ... +55 °C
Transport ¹⁾	Class 2K4 acc. to EN 60721-3-2 Temperature: -25 ... +70 °C max. Air humidity: 95% at +40°C
Operation	Class 3K3 according to EN 60721-3-3 Temperature: 0 ... +40 °C without derating > 40 ... +55 °C with reduction of the output current by 2.67 % pro °C Relative humidity: 5 ... 90 % no condensation Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted
Mechanical environmental conditions	
Long-term storage	-
Transport ¹⁾	Class 2M2 according to EN 60721-3-2
Operation	
Vibration test in operation	According to IEC 60068-2-6 test Fc (sinusoidal) <ul style="list-style-type: none"> • 10 ... 57 Hz: 0.075 mm deflection amplitude • 57 ... 150 Hz: 1g acceleration amplitude
Shock test in operation	According to IEC 60068-2-27 test Ea (half-sine) <ul style="list-style-type: none"> • 10 g peak acceleration • 20 ms duration
Installation altitude	
Operation	0 ... 2000 m above sea level without derating > 2000 ... 4000 m <ul style="list-style-type: none"> • Reduction of the output current by 10 % per 1000 meters, or • Reduction of the ambient temperature by 5°C per 1000 meters • Operation on line supply systems with grounded neutral point, or • Operation on an isolating transformer with secondary grounded neutral point

¹⁾ In transport packaging

Table 3- 8 Certificates

Declarations of Conformity	CE (Low Voltage, EMC and Machinery Directives)
Approvals	cULus, cURus Testing by UL (Underwriters Laboratories (https://www.ul.com)) according to UL and CSA standards RCM (C-Tick)

Mains connection and line-side power components

4.1 Introduction

The following line-side components should be used to connect a SINAMICS drive to the line supply:

- Line disconnecter
This does not have been a separate component, but can also be a fused disconnecter or load disconnecter.
- Overcurrent protection device (line fuses or circuit-breaker)
- Line contactor (optional)
- Line filter (optional)
- Line reactor for FSA to FSC (optional)

The possible supply voltages for the drive are:

- For PM240-2 FSA, FSB and FSC Power Modules, blocksize format:
 - 1 AC: 200 V ... 240 V ± 10 %
 - 3 AC: 200 V ... 240 V ± 10 %
 - 3 AC: 380 V ... 480 V ± 10 %
- For PM240-2 FSD, FSE and FSF Power Modules, blocksize format:
 - 3 AC: 200 V ... 240 V ± 10 % (in operation -20 % < 1 min)
 - 3 AC: 380 V ... 480 V ± 10 % (in operation -20 % < 1 min)
 - 3 AC: 500 V ... 690 V ± 10 % (in operation -20 % < 1 min)
- For PM240-2 FSG blocksize Power Modules:
 - 3 AC: 380 V ... 480 V ± 10 % (in operation -20 % < 1 min)
 - 3 AC: 500 V ... 690 V ± 10 % (in operation -20 % < 1 min)
- For Power Modules, chassis format:
 - 3 AC: 380 V... 480 V ± 10 %

The following line reactor variants are available:

- 4 versions for chassis format
- 5 versions for chassis format

The following line filter variants are available:

- Integrated versions for the blocksize format to comply with EMC category C2 or C3
- External versions for the chassis format to comply with EMC category C2 or C3

4.1 Introduction

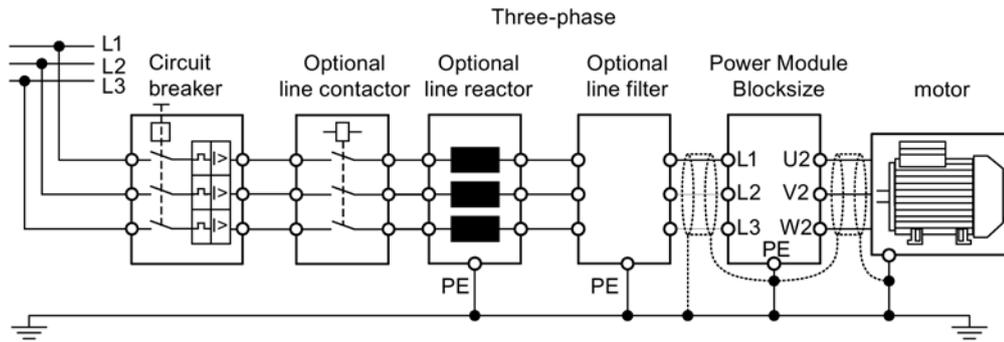


Figure 4-1 Example of a Blocksize line connection (FSA to FSC)

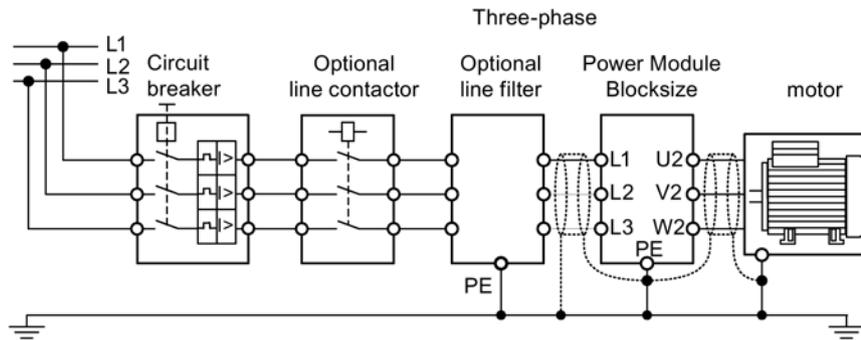


Figure 4-2 Example of a blocksize line connection (FSD to FSG)

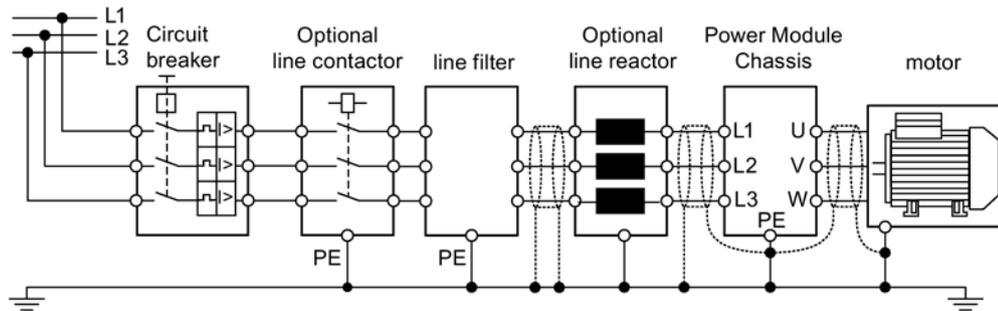


Figure 4-3 Example of a chassis line connection

4.2 Information on the disconnecter unit

A line disconnecter is required for disconnecting the drive line-up from the supply system. This must be selected in compliance with local regulations.

The accessories required for the line disconnecter must be selected from the manufacturer catalogs.

NOTICE

Damage to the drive electronics when switching the line disconnection equipment under load

When switching the line disconnection equipment (type according to the recommended selection) under load, then the contacts will be subject to premature wear. This can cause the line disconnection equipment to malfunction, with subsequent damage to the drive electronics.

- Use a leading, opening auxiliary contact.
- If this is not possible, then avoid switching the line disconnection equipment under load.

4.3 Overcurrent protection by means of line fuses and circuit breakers



⚠ WARNING

Electric shock or fire due to overcurrent protective equipment that trips too late or not at all

Overcurrent protective equipment that trips too late or not at all can cause electric shock or fire.

- In the case of a conductor-conductor or conductor-ground short-circuit, ensure that the short-circuit current at the point where the converter is connected to the line supply corresponds as a minimum to the requirements of the protective equipment used.
- You must additionally use a residual-current protective device (RCD) if, for a conductor-ground short circuit, the required short-circuit current is not reached. The required short-circuit current can be too low, especially for TT line supply systems.
- The short-circuit current must not exceed the SCCR of the converter and the breaking capacity of the protective equipment.

4.3.1 Power Modules, blocksize format

The Power Modules are suitable for a rated short-circuit current (SCCR) up to 100 kA. You must use line fuses or circuit breakers for overcurrent protection. The following protective elements can result in reductions.

Detailed information on the protective devices is provided in the product information "Protective devices for Power Modules PM240-2

(<https://support.industry.siemens.com/cs/de/de/view/109486009>)".

4.3.2 Power Modules chassis format

4.3.2.1 Line fuses and circuit breaker for Power Modules, chassis format

Table 4- 1 Fuses and circuit breaker for Power Modules, chassis format, line voltage 3 AC 380 ... 480 V

Article number		6SL3310-1TE32-1AA3	6SL3310-1TE32-6AA3	6SL3310-1TE33-1AA3	6SL3310-1TE33-8AA3	6SL3310-1TE35-0AA3
LV HRC fuses Rated current	A	3NA3144 250	3NA3250 300	3NA3254 355	3NA3260 400	3NA3372 630
IEC fuses, type NE Rated current Rated short-circuit current I _{cc}	A kA	3NE1227 250 65	3NE1230 315 65	3NE1331 350 65	3NE1332 400 65	3NE3336 630 65
Circuit breaker type designation Rated current	A	3VL4725-1DC36-0AA0 200 ... 250	3VL4731-1DC36-0AA0 250 ... 315	3VL4740-1DC36-0AA0 320 ... 400	3VL5750-1DC36-0AA0 400 ... 500	3VL5763-1DC36-0AA0 500 ... 630
Circuit breaker type designation UL489 / CSA C22.2 No. 5-02 Rated current Rated short-circuit current SCCR	A kA	3VL3125-3KN30-0AA0 250 65	3VL4130-3KN30-0AA0 300 65	3VL4135-3KN30-0AA0 350 65	3VL4140-3KN30-0AA0 400 65	3VL4560-3KN30-0AA0 600 65

4.4 Using residual current protective devices (RCD)

Residual current protective devices must be installed if the loop impedance at the line connection point is so high that in the case of a phase-ground short-circuit, the overcurrent protective devices do not trip within the specified time.

Conditions for using residual current protective devices

- Super-resistant (short time-delayed) universal current-sensitive RCDs, type B
- Rated fault current, 300 mA
- Separate RCD for each Power Module

Recommendation for PM240-2, FSA-FSD 200 V and 400 V:

Siemens SIQUENCE ground-fault circuit interrupter (RCCB) 5SM3 type B

Recommendation for PM240-2, FSE-FSF 200 V, FSE-FSG 400 V as well as FSD-FSG 690 V:

Siemens modular residual current protective device (MRCD) 5SV81 type B in conjunction with Siemens 3VA1 circuit breakers

 WARNING**Fire or plant/system standstill when fault currents occur**

Undetected fault currents in the power supply can result in fires with smoke and therefore pose a hazard for persons or at least result in failures of the entire plant.

- Always install residual current protective devices in conjunction with suitable circuit breakers.

4.5 Line contactors

When selecting a line contactor, the characteristic values in the technical data apply. The cables and conductors to be connected must be dimensioned in compliance with local installation regulations.

NOTICE**Damage to the drive electronics when switching the line contactor under load**

If you switch the line contactor (recommended type) under load, the contacts will wear out prematurely. This may lead to faulty functioning of the contactor with subsequent damage to the drive electronics.

- Use a leading, opening auxiliary contact.
- If this is not possible, avoid switching the line contactor under load.

Note

To limit the switching overvoltage, the contactor coil must be connected to a surge suppression device (e.g. freewheeling diode or varistor).

When a digital output is used to control the line contactor, its switching capacity must be taken into account.

4.6 Line filter

4.6.1 Description

In conjunction with a system configuration that is consistently designed to ensure EMC, line filters limit the interference emitted by the Power Modules to limit values according to EN 61800-3.

Power Modules blocksize are available in versions with internal line filters (excluding Power Modules 200 V, FSD-FSF). The limit values of EMC categories C2 and C3 can be complied with when using these filters.

Power Modules blocksize without an internal line filter require an external line filter in order to comply with Category C3. Otherwise, it is only permissible to be used with an IT line system, Category C4.

For Power Modules belonging to the 400 V series, without integrated line filter, external line filters are available with which Category C1 (cable conducted) can be complied with:

- FSA to FSC: line filter from Siemens AG that can be used as footprint component
- FSD to FSF: You can obtain information about line filters through our "Siemens Product Partners for Drive Options (<https://w3.siemens.com/mcms/mc-drives/de/niederspannungsumrichter/sinamics-zubehoer/Seiten/sinamics-zubehoer.aspx>)".

External line filters are available for Power Modules in the chassis format to comply with limit values of EMC Categories C2 or C3.

4.6.2 Safety instructions for line filters


! WARNING
Electric shock in the event of missing touch protection

Touching live components can result in death or serious injury.

- For the line filter, use touch protection according to IPXXA or corresponding to the local installation regulations.


! WARNING
Electric shock caused by high leakage currents when the protective conductor in the line feeder cable is interrupted

Drive components conduct high discharge currents via the protective conductor. Touching conductive parts when the protective conductor is interrupted can result in death or serious injury.

- Ensure that for increased leakage currents, the local regulations for protective conductors at the installation site are complied with.
 - Within a machine/system, ensure that the protective conductor fulfills at least one of the following conditions:
For fixed connection:
 - The protective conductor is routed so that it is protected against mechanical damage along its complete length.¹⁾
 - As a conductor of a multi-conductor cable, the protective conductor has a cross-section $\geq 2.5 \text{ mm}^2 \text{ Cu}$.
 - For an individual conductor, the protective conductor has a cross-section $\geq 10 \text{ mm}^2 \text{ Cu}$.
 - The protective conductor consists of two conductors with the same cross-section.
 When establishing the connection using an industrial plug connector according to EN 60309:
 - As a conductor of a multi-conductor cable, the protective conductor has a cross-section $\geq 2.5 \text{ mm}^2 \text{ Cu}$.
- ¹⁾ Cables routed within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.

! WARNING
Fire through overheating due to insufficient ventilation clearances

Insufficient ventilation clearances result in overheating with danger to persons as a result of smoke and fire. Further, the line filter can be thermally damaged.

- Ensure 100-mm ventilation clearances above and below the line filter.

4.6 Line filter

NOTICE
Damage due to multiple loads being connected to the same line infeed point Components can be damaged if several loads (consumers) are connected to the same line infeed point. <ul style="list-style-type: none">• Suppress interference on the additional loads using appropriate line filters.
NOTICE
Line filter damage due to interchanged connections Interchanging the input and output connections will damage the line filters. <ul style="list-style-type: none">• Connect the incoming line supply cable to LINE L1, L2, L3.• Connect the outgoing cable to the Power Module at LOAD/LAST L1', L2', L3' (U, V, W).
NOTICE
Damage to loads due to the incorrect line filter Unsuitable line filters can cause line harmonics, which damage or destroy loads connected to the same line supply. <ul style="list-style-type: none">• Only use line filters released by Siemens for SINAMICS.

4.6.3 Electromagnetic compatibility (EMC) of the system

An explanation of the EMC environment and EMC Categories is provided in Chapter "Environments and categories (Page 368)".

Category C1

Under the following conditions, the Power Modules comply with the limit values of Category C1:

- A Power Module blocksize PM240-2 FSA, FSB, FSC with external line filter is used.
- A shielded motor cable with low capacitance is used.
- The motor cable is shorter than 50 m. The pulse frequency is less than or equal to the rated pulse frequency.
- The current is less than or equal to the rated input current listed in the Technical data

Power Modules that comply with the limit values of category C1 are intended for use in the first environment. For more details, see Chapter "Interference emissions and interference immunity (Page 370)".

Category C2

Under the following conditions, the Power Modules comply with the limit values of category C2:

- A Power Module in the blocksize format with internal line filter or a Power Module in the chassis format with external line filter is used.
- A shielded motor cable with low capacitance is used.
- The motor cable is
 - For Power Modules in the blocksize format, FSA to FSC \leq 50 m.
 - for Power Modules in the blocksize format, FSD to FSG \leq 150 m.
 - For Power Modules in the chassis format \leq 100 m.
- The pulse frequency \leq rated pulse frequency.
- The current \leq rated input current in the technical data.

For Power Modules in the chassis format an external line reactor is required to achieve Category C2.

Category C3

Power Modules in the blocksize format with an integrated line filter - or Power Modules in the chassis format with an appropriate external line filter meet the limit values for Category C3.

Almost all Power Modules blocksize are available with integrated line filter. The only exclusion are the 200 V modules, frame sizes FSD to FSF.

Power Modules, Category C3 and can only be used in the second environment.

Category C4

Unfiltered Power Modules meet Category C4 and can only be used in the second environment when connected to IT line supplies.

4.6 Line filter

4.6.4 Dimension drawings

Blocksize line filter

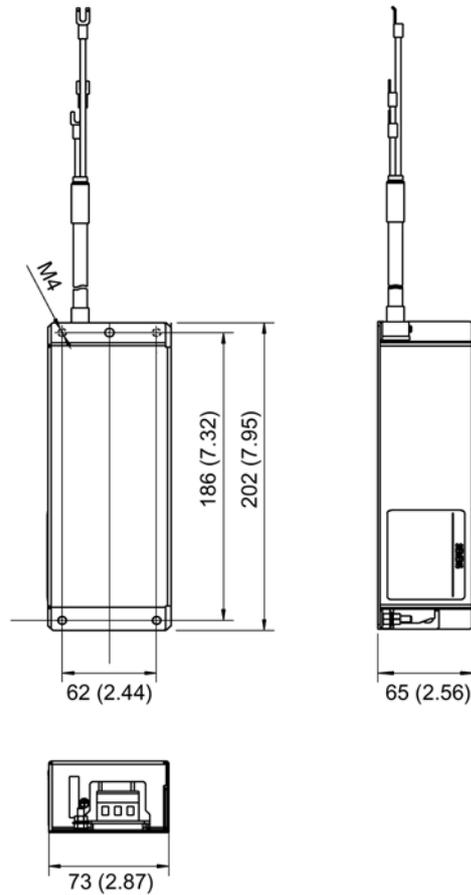


Figure 4-4 Dimension drawing of the line filter, Power Module PM240-2 frame size FSA, all data in mm (inches)

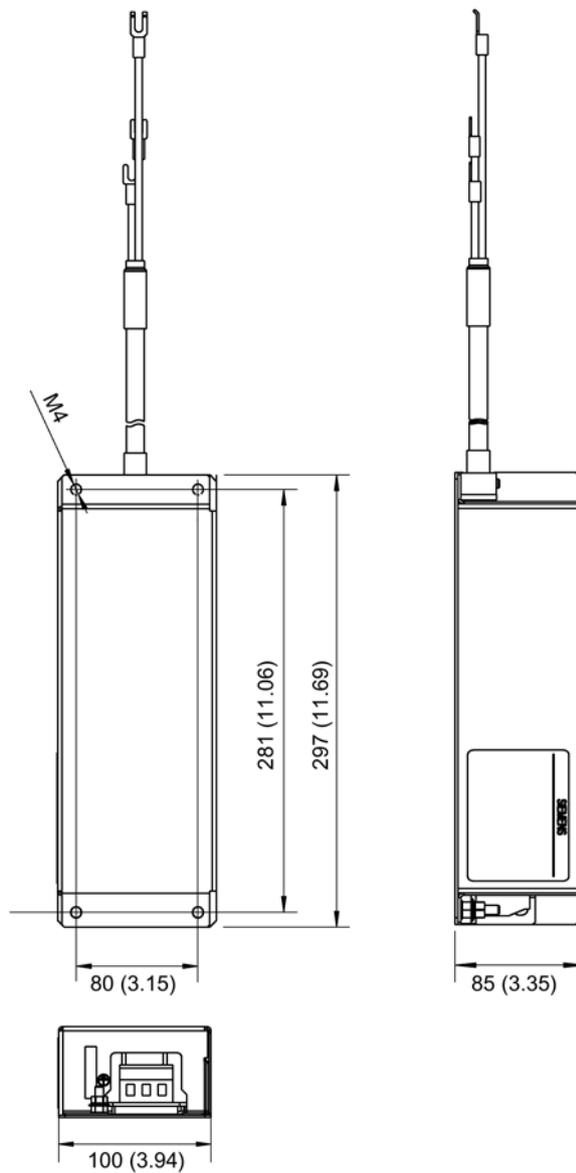


Figure 4-5 Dimension drawing of the line filter, Power Module PM240-2 frame size FSB, all data in mm (inches)

4.6 Line filter

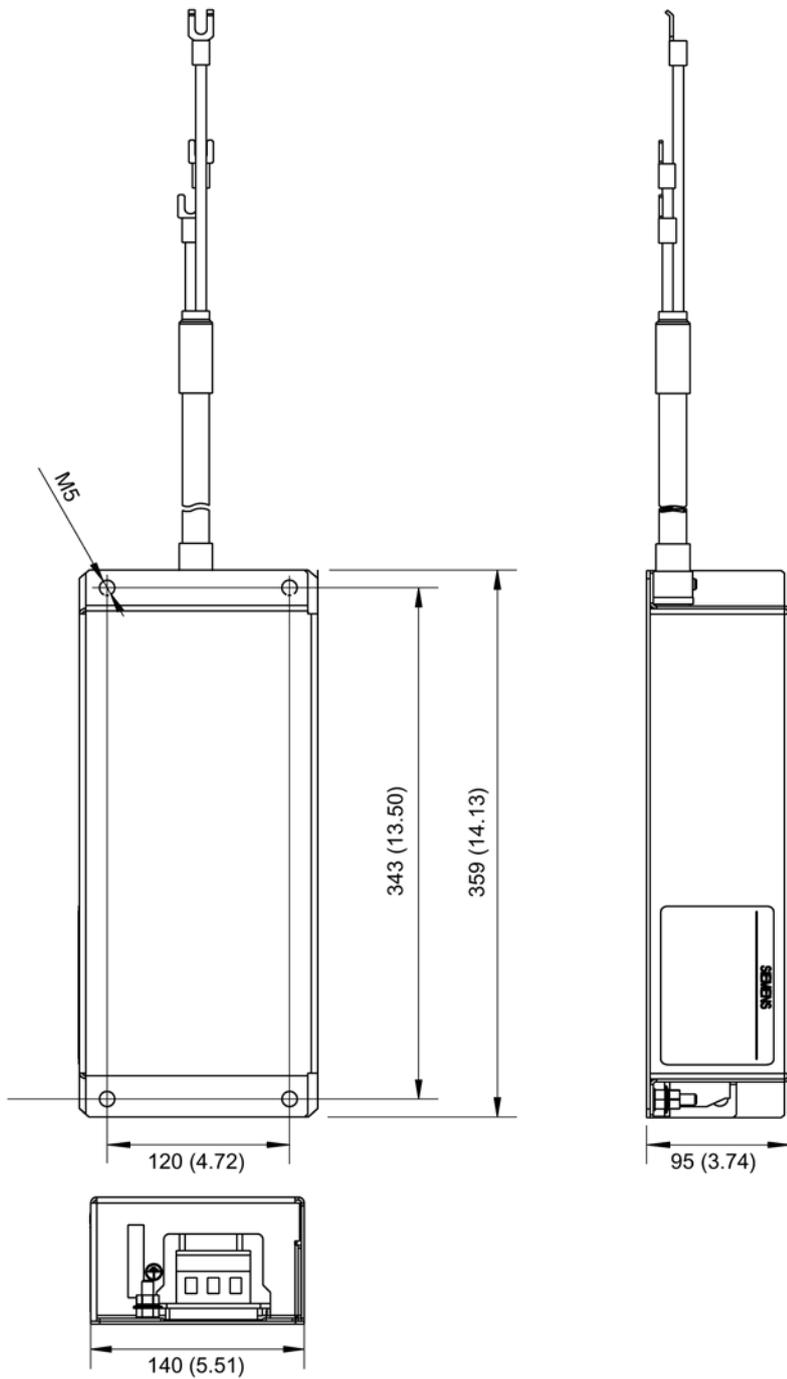


Figure 4-6 Dimension drawing of the line filter, Power Module PM240-2 frame size FSC, all data in mm (inches)

Chassis line filter

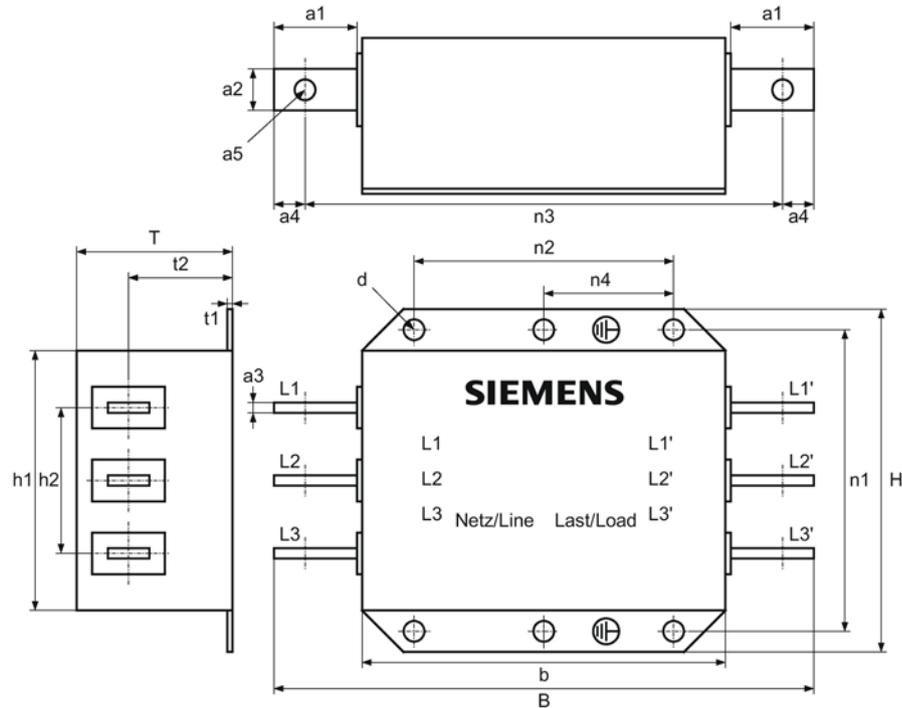


Figure 4-7 Dimension drawing, line filter

Table 4- 2 Dimensions of the line filter, all data in mm and (inches)

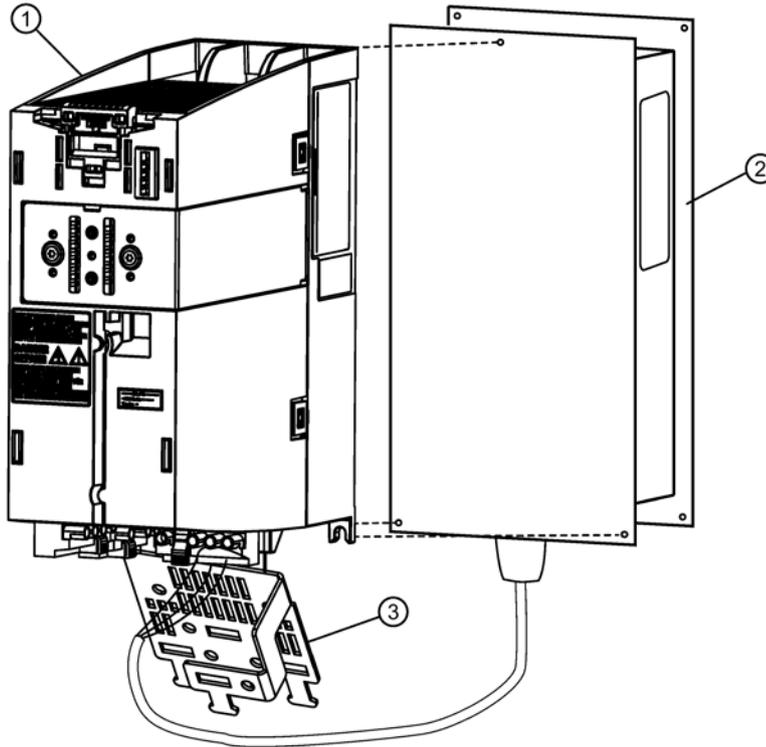
6SL3000-	0BE32-5AA0	0BE34-4AA0	0BE36-0AA0
B	360 (14.17)	360 (14.17)	400 (15.74)
H	240 (9.44)	240 (9.44)	265 (10.43)
D	116 (4.56)	116 (4.56)	140 (5.51)
a1	40 (1.57)	40 (1.57)	40 (1.57)
a2	25 (0.98)	25 (0.98)	25 (0.98)
a3	5 (0.19)	5 (0.19)	8 (0.31)
a4	15 (0.59)	15 (0.59)	15 (0.59)
a5	11 (0.43)	11 (0.43)	11 (0.43)
b	270 (10.62)	270 (10.62)	310 (12.20)
h1	200 (7.87)	200 (7.87)	215 (8.46)
h2	100 (3.93)	100 (3.93)	120 (4.72)
t1	2 (0.07)	2 (0.07)	3 (1.18)
t2	78,2 (3.07)	78,2 (3.07)	90 (3.54)
n1 ¹⁾	220 (8.66)	220 (8.66)	240 (9.44)
n2 ¹⁾	210 (8.26)	210 (8.26)	250 (9.84)
n3	330 (12.99)	330 (12.99)	370 (14.56)
n4	-	-	125 (4.92)
d	9 (0.35)	9 (0.35)	12 (0.47)

¹⁾ Lengths n1 and n2 correspond to the distance between holes

4.6 Line filter

4.6.5 Mounting

External line filters for Power Modules in the blocksize format are designed as base components. The line filter is retained on the mounting surface and the Power Module is mounted on the line filter in a space-saving fashion. The cables to the Power Modules are already connected at the line filter. The line filter is connected to the line supply through terminals.



- ① PM240-2 Power Module, frame size FSA
- ② Line filter
- ③ Shield connection

Figure 4-8 Installation example: Power Module PM240-2 (frame size FSA) with screening kit and line filter

Table 4-3 Connecting the line filter for the PM240-2 on the mounting surface

Frame size	Fastening	Tightening torque
FSA	4 x M4 bolts	2.5 Nm (22.1 lbf in)
FSB		
FSC	4 x M5 bolts	3 Nm (26.6 lbf in)

Table 4-4 Connecting Power Module PM240-2 to the line filter

Frame size	Fastening	Tightening torque
FSA	3 x M4 bolts	2.5 Nm (22.1 lbf in)
FSB	4 x M4 bolts	2.5 Nm (22.1 lbf in)
FSC	4 x M5 bolts	3 Nm (26.6 lbf in)

4.6.6 Technical data

4.6.6.1 Technical data, Blocksize line filter

Table 4- 5 Technical data of line filter Blocksize PM240-2

Line voltage 3-phase 380 ... 480 VAC				
Line filter 6SL3203-		OBE17-7BA0	OBE21-8BA0	OBE23-8BA0
Frame size		FSA	FSB	FSC
Suitable for Power Module		Line voltage 3-phase 380 VAC - 10% to 480 VAC + 10%:		
		6SL3210-1PE11-8UL1 6SL3210-1PE12-3UL1 6SL3210-1PE13-2UL1 6SL3210-1PE14-3UL1 6SL3210-1PE16-1UL1 6SL3210-1PE18-0UL1 6SL3211-1PE18-0UL1	6SL3210-1PE21-1UL0 6SL3210-1PE21-4UL0 6SL3210-1PE21-8UL0 6SL3211-1PE21-8UL0	6SL3210-1PE22-7UL0 6SL3210-1PE23-3UL0 6SL3211-1PE23-3UL0
Type rating of the Power Modules based on I _n	kW	0.55 ... 3.0	4.0 ... 7.5	11.0 ... 15.0
Rated current	A	11.4	23.5	49.4
Power loss	W	13	22	39
Line supply connection L1, L2, L3		Max. connectable cross-section: 2.5 mm ² (AWG 14) Tightening torque: 0.6 ... 0.8 Nm (5.3 ... 7.1 lbf in)	Max. connectable cross-section: 6 mm ² (AWG 10) Tightening torque: 1.5 ... 1.8 Nm (13.3 ... 15.9 lbf in)	Max. connectable cross-section: 16 mm ² (AWG 6) Tightening torque: 2.0 ... 2.3 Nm (17.7 ... 20.4 lbf in)
Load connection L1', L2', L3', 		Cable (including ) at the line filter		
Protective conductor connection 		Max. connectable cross-section: 2.5 mm ² (AWG 14) Tightening torque: 2 ±0.1 Nm (17.7 ±0.9 lbf in)	Max. connectable cross-section: 6 mm ² (AWG 10) Tightening torque: 2 ±0.1 Nm (17.7 ±0.9 lbf in)	Max. connectable cross-section: 16 mm ² (AWG 6) Tightening torque: 3 ±0.5 Nm (26.6 ±4.4 lbf in)
Degree of protection		IP20	IP20	IP20
Weight	kg	1.75	4.0	7.3

4.6.6.2 Technical data, Chassis line filter

Table 4- 6 Technical data, Chassis line filter

Article number	6SL3000-	OBE32-5AA0	OBE34-4AA0	OBE34-4AA0	OBE34-4AA0	OBE36-0AA0
Suitable for Power Module	6SL3310-	1TE32-1AA.	1TE32-6AA.	1TE33-1AA.	1TE33-8AA.	1TE35-0AA.
Unit rating of the Power Module	kW	110	132	160	200	250
Rated voltage	V	380 V 3 AC -10 % ... 480 V 3 AC +10 % (-15 % < 1 min), 47 ... 63 Hz				
Rated current	A	250	440	440	440	600
Power loss	kW	0.015	0.047	0.047	0.047	0.053

4.6 Line filter

Article number	6SL3000-	0BE32-5AA0	0BE34-4AA0	0BE34-4AA0	0BE34-4AA0	0BE36-0AA0
Line supply/load connection L1, L2, L3 / L1', L2', L3'		M10	M10	M10	M10	M10
Protective conductor connection		M8	M8	M8	M8	M10
Degree of protection		IP00	IP00	IP00	IP00	IP00
Dimensions						
Width	mm	360	360	360	360	400
Height	mm	240	240	240	240	265
Depth	mm	116	116	116	116	140
Weight	kg	12.3	12.3	12.3	12.3	19.0

4.7 Line reactors

4.7.1 Description

The line reactors limit low-frequency line harmonics and reduce the load on the rectifiers in the Power Modules. They are used to smooth voltage spikes (line supply faults) or to bridge voltage dips/interruptions when commutating. This is why we recommend that line reactors are used in conjunction with Power Modules in the blocksize and chassis formats.

PM240-2 FSD to FSG Power Modules have an integrated DC link reactor - and therefore do not require a line reactor.

4.7.2 Safety instructions for line reactors



! WARNING

Electric shock in the event of missing touch protection

Touching live components can result in death or serious injury.

- For the line reactors, use touch protection according to IPXXA or corresponding to the local installation regulations.

! WARNING

Fire through overheating due to insufficient ventilation clearances

Insufficient ventilation clearances can result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of components shortened.

- Maintain 100 mm ventilation clearances above and below the component.



! CAUTION

Burns resulting from high surface temperature of the line reactor

The surface temperature of the line reactors may exceed 80° C. Contact with the surface will cause you to suffer severe burn injuries.

- Mount the line reactor so that it cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

4.7 Line reactors

NOTICE

Damage to the system due to impermissible line reactors

An impermissible line reactor may cause damage to the system and any further loads operated on the same power network.

- Only use line reactors that SIEMENS has released for SINAMICS.

NOTICE

Line reactor damage due to interchanged connections

Interchanging the input and output connections will damage the line reactor.

- Connect the incoming line cable at 1L1, 1L2, 1L3 or 1U1, 1V1, 1W1.
- Connect the outgoing cable to the load at 2L1, 2L2, 2L3 or 1U2, 1V2, 1W2.

Note

Malfunctions through magnetic fields

Reactors produce magnetic fields that can disturb or damage components and cables.

- Arrange the components and cables at a suitable distance (at least 200 mm) or shield the magnetic fields appropriately.

Note

Connection cables

- Keep the connecting cables to the Power Module short (max. 5 m.)
- Use shielded connection cables.

4.7.3 Dimension drawings

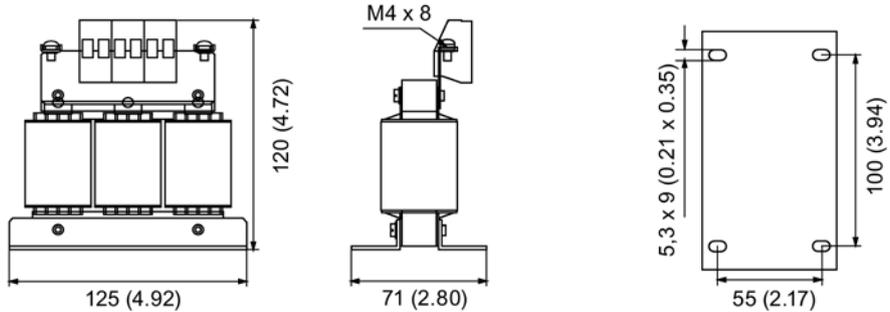


Figure 4-9 Dimensional drawing of line reactors, PM240-2 frame size FSA, 0.55 ... 1.1 kW, all dimensions in mm and (inch)

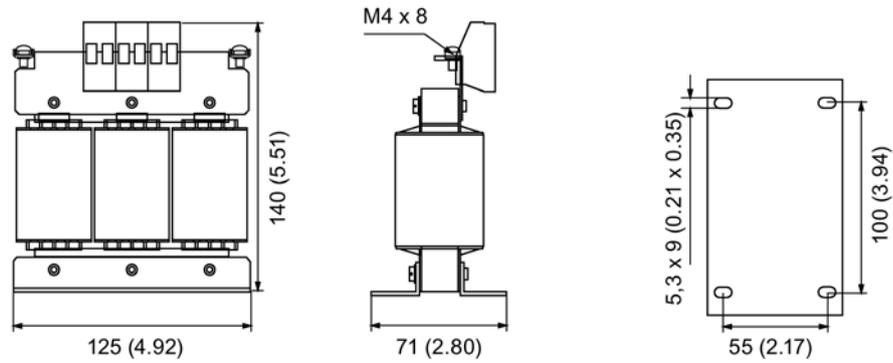


Figure 4-10 Dimensional drawing of line reactors, PM240-2 frame size FSA, 1.5 ... 4.0 kW, all dimensions in mm and (inch)

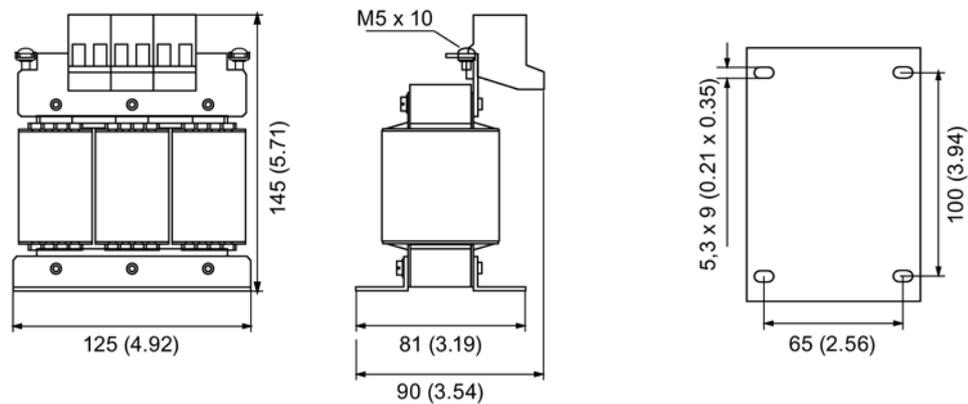


Figure 4-11 Dimensional drawing of line reactors, PM240-2, frame size FSB, 4.0 ... 7.5 kW, all dimensions in mm and (inch)

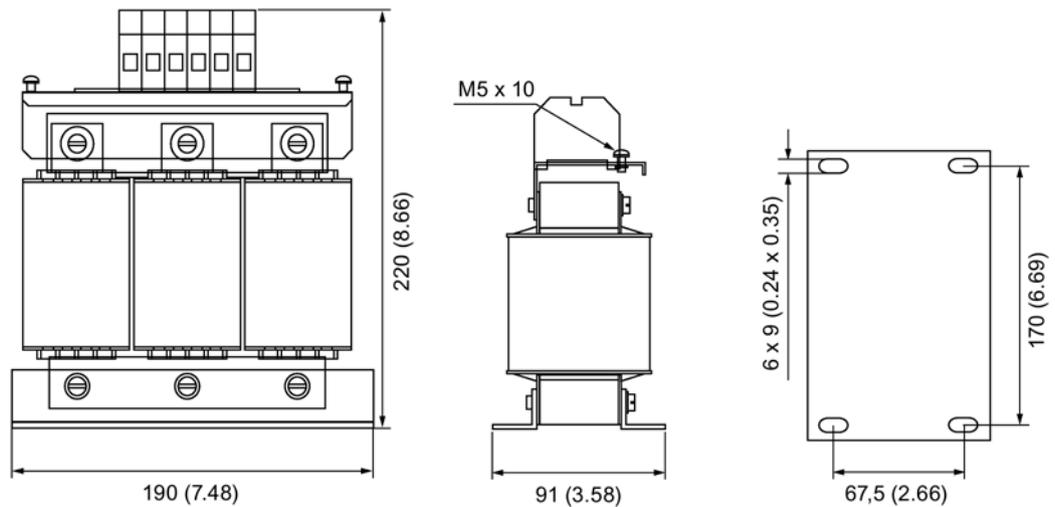
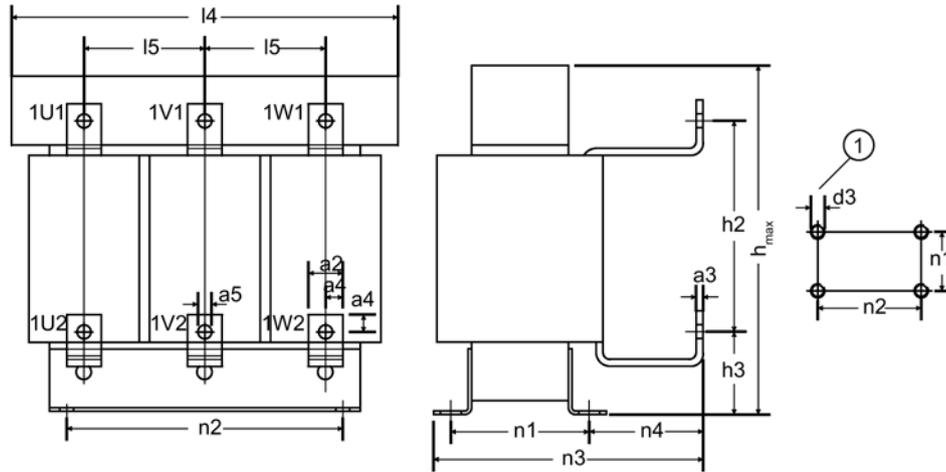


Figure 4-12 Dimensional drawing of line reactors, PM240-2, frame size FSC, 11 ... 15 kW, all dimensions in mm and (inch)

4.7 Line reactors

Chassis line reactors



① Mounting hole

Figure 4-13 Dimension drawing, line reactors

Table 4- 7 Dimensions of the line reactors, all data in mm (inches)

6SL3000-	0CE32-3AA0	0CE32-8AA0	0CE33-3AA0	0CE35-1AA0
a2	25 (0.98)	25 (0.98)	25 (0.98)	30 (1.18)
a3	5 (0.19)	5 (0.19)	5 (0.19)	6 (0.23)
a4	12.5 (0.49)	12.5 (0.49)	12.5 (0.49)	15 (0.59)
a5	11 (0.43)	11 (0.43)	11 (0.43)	14 (0.55)
l4	270 (10.62)	270 (10.62)	270 (10.62)	300 (11.81)
l5	88 (3.46)	88 (3.46)	88 (3.46)	100 (3.93)
hmax	248 (9.76)	248 (9.76)	248 (9.76)	269 (10.59)
h2	150 (5.90)	150 (5.90)	150 (5.90)	180 (7.08)
h3	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)
n1 ¹⁾	101 (3.97)	101 (3.97)	101 (3.97)	118 (4.64)
n2 ¹⁾	200 (7.87)	200 (7.87)	200 (7.87)	224 (8.81)
n3	200 (7.87)	200 (7.87)	200 (7.87)	212.5 (8.36)
n3	84.5 (3.32)	84.5 (3.32)	84.5 (3.32)	81 (3.19)
d3	M8	M8	M8	M8

¹⁾ Lengths n1 and n2 correspond to the distance between holes.

4.7.4 Mounting

Blocksize line reactors

The line reactors for Power Modules PM240-2 of frame sizes FSA to FSC are designed for installation in a cabinet. The line reactor is connected to the line supply through terminals.

Mounting position:

- On the mounting surface next to the Power Module: hanging horizontally or
- On the electrical cabinet floor section: vertical, upright

Table 4- 8 Connecting the line reactor for the PM240-2 on the mounting surface

Frame size	Fastening	Tightening torque
FSA	4 x M5 screws	6 Nm (53.1 lbf in)
FSB	4 x M5 nuts	
	4 x M5 washers	
FSC	4 x M6 screws	10 Nm (88.5 lbf in)
	4 x M6 nuts	
	4 x M6 washers	

Chassis line reactors

The line reactors for Power Modules, frame sizes FX, and GX are, as a result of their weight and their size, mounted separately.

4.7.5 Electrical Connection

Line/load connection

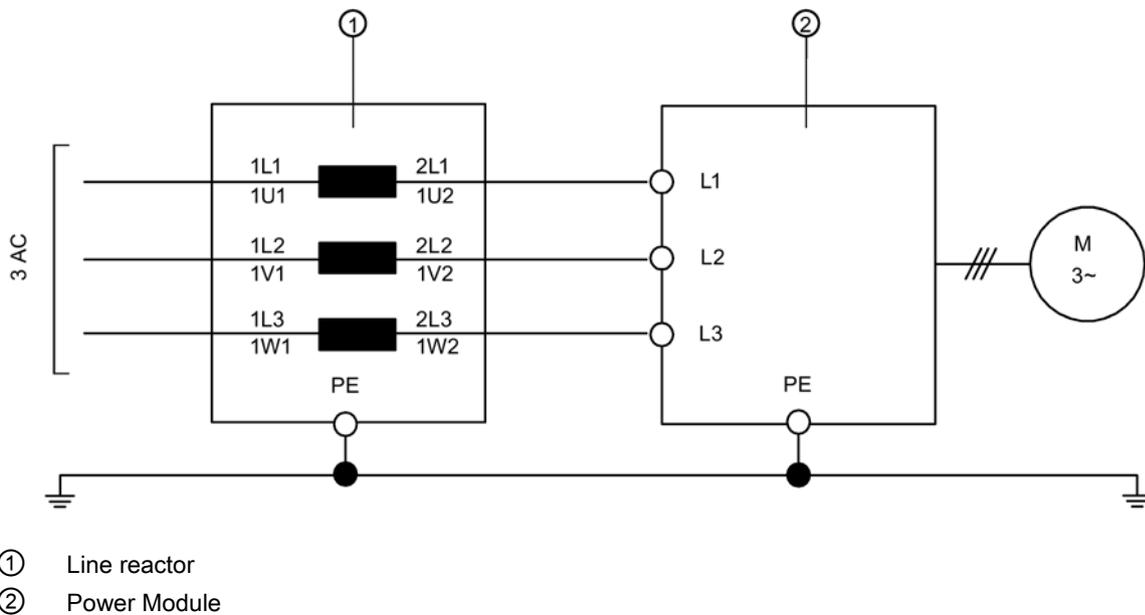


Figure 4-14 Power Module with line filter

4.7 Line reactors

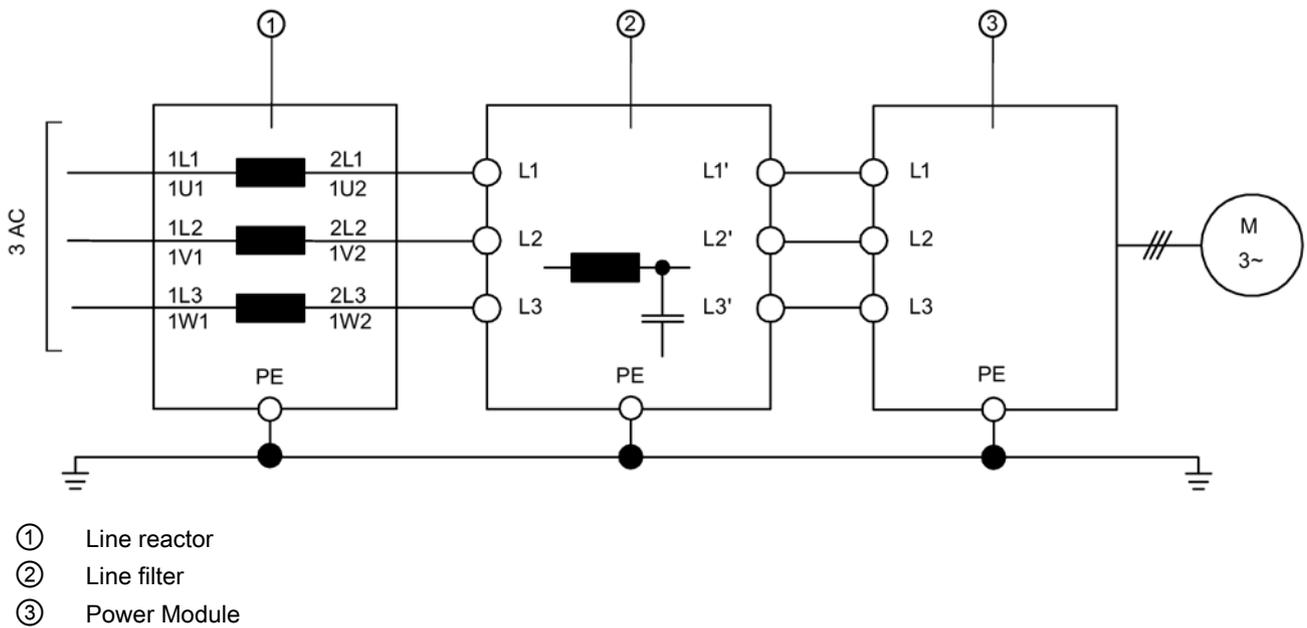


Figure 4-15 Power Module with line reactor and line filter

4.7.6 Technical data

4.7.6.1 Blocksize line reactors

Table 4-9 Technical data for PM240-2 line reactors

Article No. 6SL3203-	0CE13-2AA0	0CE21-0AA0	0CE21-8AA0	0CE23-8AA0
Frame size	FSA	FSA	FSB	FSC
Matching Power Modules ¹⁾	Line voltage 1-phase 200 VAC -10% to 240 VAC +10%:			
	6SL3210- 1PB13-0□L0 1PB13-8□L0	6SL3210- 1PB15-5□L0 1PB17-4□L0 1PB21-0□L0 6SL3211- 1PB21-0□L0	6SL3210- 1PB21-4□L0 1PB21-8□L0 6SL3211- 1PB21-8□L0	6SL3210- 1PC22-2□L0 1PC22-8□L0 6SL3211- 1PC22-2□L0 1PC22-8□L0
	Line voltage 3-phase 380 VAC -10% to 480 VAC +10%:			
	6SL3210- 1PE11-8□L1 1PE12-3□L1 1PE13-2□L1	6SL3210- 1PE14-3□L1 1PE16-1□L1 1PE18-0□L1 6SL3211- 1PE18-0□L1	6SL3210- 1PE21-1□L0 1PE21-4□L0 1PE21-8□L0 6SL3211- 1PE21-8□L0	6SL3210- 1PE22-7□L0 1PE23-3□L0 6SL3211- 1PE23-3□L0
Inductance	mH 2.5	1.0	0.5	0.3

Article No. 6SL3203-		OCE13-2AA0	OCE21-0AA0	OCE21-8AA0	OCE23-8AA0
Unit rating of the Power Module	kW	0.55 ... 1.1	1.5 ... 4.0	4.0 ... 7.5	11 ... 15
Rated current	A	4.0	11.3	22.3	47.0
Power loss 50/60 Hz	W	23 / 25.3	36 / 39.6	53 / 58.3	88 / 96.8
Line/load connection 1L1, 1L2, 1L3 2L1, 2L2, 2L3		Max. connectable cross-section: 2.5 mm ² (AWG 14) Tightening torque: 0.6 ... 0.8 Nm (5.3 ... 7.1 lbf in)	Max. connectable cross-section: 2.5 mm ² (AWG 14) Tightening torque: 0.6 ... 0.8 Nm (5.3 ... 7.1 lbf in)	Max. connectable cross-section: 6 mm ² (AWG 10) Tightening torque: 1.5 ... 1.8 Nm (13.3 ... 15.9 lbf in)	Max. connectable cross-section: 16 mm ² (AWG 6) Tightening torque: 2.0 ... 4.0 Nm (17.7 ... 35.4 lbf in)
Protective conductor connection		Type: M4 bolts Tightening torque: 3 Nm (26.6 lbf in)	Type: M4 bolts Tightening torque: 3 Nm (26.6 lbf in)	Type: M5 bolts Tightening torque: 5 Nm (44.3 lbf in)	Type: M5 bolts Tightening torque: 5 Nm (44.3 lbf in)
Degree of protection		IP20	IP20	IP20	IP20
Weight	kg	1.1	2.1	2.95	2.95

1) □ = A: Power Module with integrated line filter, □ = U: Power Module without integrated line filter

4.7.6.2 Chassis line reactors

Table 4- 10 Technical data, Chassis line reactors

Article number	6SL3000-	OCE32-3AA0	OCE32-8AA0	OCE33-3AA0	OCE35-1AA0	OCE35-1AA0
Suitable for Power Module	6SL3310-	1TE32-1AA.	1TE32-6AA.	1TE33-1AA.	1TE33-8AA.	1TE35-0AA.
Rated current of the Power Module	A	210	260	310	380	490
Rated voltage	V	380 V 3 AC - 10 % ... 480 V 3 AC + 10 % (-15 % < 1 min), 47 ... 63 Hz				
I _{thmax}	A	224	278	331	508	508
Power loss	kW	0.274	0.247	0.267	0.365	0.365
Line/load connection 1U1, 1V1, 1W1, 1U2, 1V2, 1W2		M10 connecting lugs	M10 connecting lugs	M10 connecting lugs	M12 connecting lugs	M12 connecting lugs
Protective conductor connection		M6 screw	M6 screw	M6 screw	M6 screw	M6 screw
Degree of protection		IP00	IP00	IP00	IP00	IP00
Weight	kg	24.5	26	27.8	38	38

4.8 Line connection variants

4.8.1 Operation on different line system configurations

The Power Modules are designed for the following power distribution systems according to IEC 60364-1.

Note

- At an installation altitude of more than 1000 m, observe the information in Chapter Current derating (Page 136).
-

TN system

In a TN system, a point of the generator or the transformer is grounded, normally the neutral point. The housing of the consumer is also connected with the ground using this cable.

Neutral conductors and protective conductors can be fed separately (N / PE) or together (PEN).

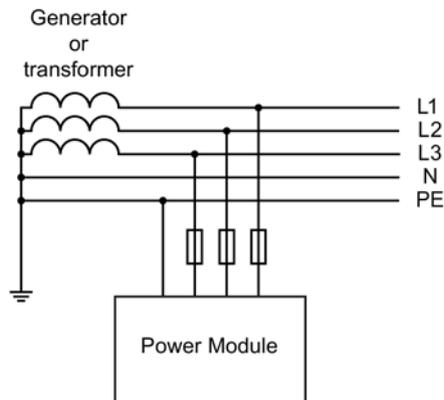


Figure 4-16 TN system

- Power Modules without line filter are permitted to be operated on all TN systems.
- Power Modules with an integrated or external line filter can be operated only in TN systems with a grounded neutral point.

TT system

In a TT system, a point of the generator or the transformer is grounded, normally the neutral point. The housing of the consumer is connected with the ground using a separate cable.

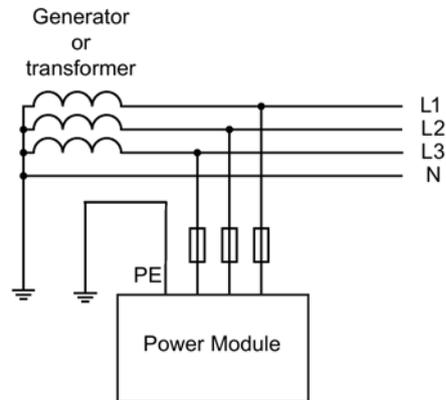


Figure 4-17 TT system

- Power Modules without a line filter can be operated on all TT systems.
- Power Modules with an integrated or external line filter can be operated only in TT systems with a grounded neutral point.

IT system

In an IT system, the voltage network is either not connected with ground or connected only using a high-resistance impedance. The housing of the consumer is connected with the ground using a separate cable.

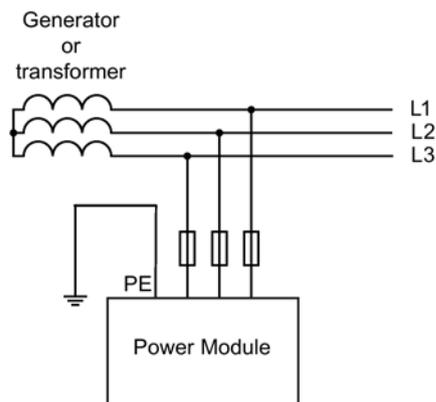


Figure 4-18 IT system

- Power Modules without a line filter can be operated in all IT systems.
- Power Modules with an integrated or external line filter cannot be operated in IT systems.

NOTICE
Damage of the drive line-up when operating on an IT system without a motor reactor
If the drive unit is operated without a motor reactor in an IT system, a ground fault on the motor side of the Power Modules can cause damage to the drive line-up or trip the overcurrent protective equipment.
<ul style="list-style-type: none">• We recommend that a motor reactor is used to provide better protection.

4.8.2 Methods of line connection

A distinction is made between the following line connection types:

- Line connection components to be directly connected to the line supply
- Operation of the line connection components via an autotransformer
- Operation of the line connection components via an isolating transformer



! WARNING
Electric shock if an isolating transformer is not used
To implement safe electrical separation, an isolating transformer must be used with high voltages. Otherwise, there is a danger to life.
<ul style="list-style-type: none">• For voltages > 3 AC 690 V, > 3 AC 480 V +10 % or 1 AC 240 V + 10 %, install an isolating transformer.

Note

Line connection of motors

In combination with the drive system, the motors are generally approved for operation on TN and TT systems with grounded neutral point and on IT systems.

In use on IT systems, the occurrence of a first fault between a live part and ground must be signaled by a monitoring device. The first fault must be removed as quickly as possible to minimize temporary overload of the motor insulation.

In all other systems, except TN and TT systems with grounded neutral point and IT systems, such as systems with a grounded line conductor, an isolating transformer with grounded neutral point (secondary side) must be connected between the supply and the drive system in order to protect the motor insulation from continuous excessive stress.

4.8.3 Operation of the line connection components on the supply line

The SINAMICS S drive system is designed to be directly connected to TN and TT systems with a grounded neutral point as well as to IT systems without line filter. Possible rated voltages:

- 3 AC 500 V to 3 AC 690 V
- 3 AC 380 V to 3 AC 480 V
- 3 AC 200 V to 3 AC 240 V
- 1 AC 200 V to 1 AC 240 V

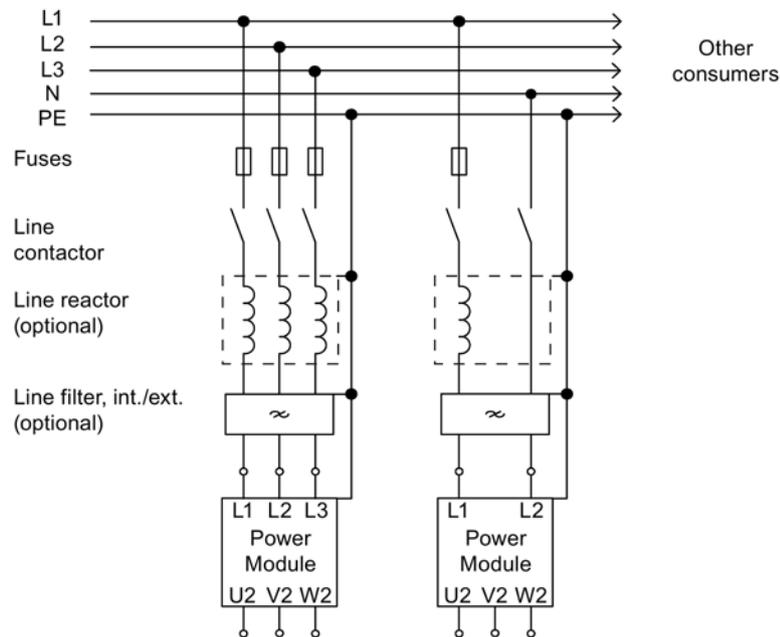


Figure 4-19 Direct operation on the line supply

Operation of single-phase units on the Single Phase Grounded Midpoint line system configuration

The line connection depicted below applies to the operation of single-phase units (1-ph. 230 VAC) on the Single Phase Grounded Midpoint line system configuration commonly used in the USA:

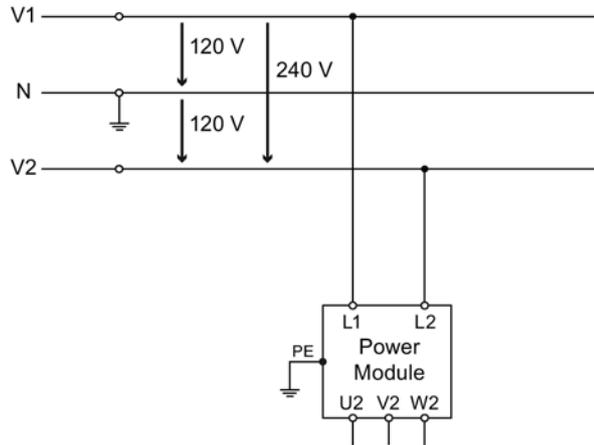


Figure 4-20 Direct operation on single phase grounded midpoint line system configurations

4.8.4 Operation of the line connection components via an autotransformer

In the range up to 3 AC 690 V +10 %, 3 AC 480 V +10 % or 1 AC 240 V +10 %, an autotransformer can be used to step up or step down the voltage.

Application example:

- The motor insulation must be protected from excessive voltages.

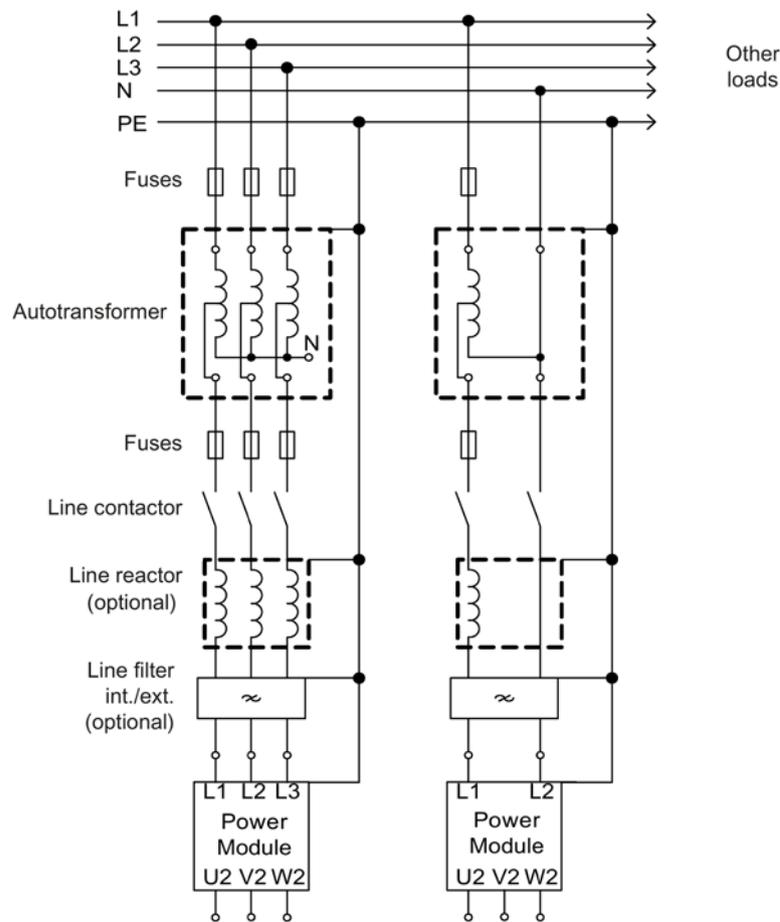


Figure 4-21 Connecting to the line supply using an autotransformer

4.8.5 Operation of the line connection components via an isolating transformer

The isolating transformer converts the type of system grounding of the installation (e.g. IT system) to a TN system with grounded neutral point. Additional voltage adaptation to the permissible voltage tolerance range is possible.

An isolating transformer must be used in the following cases:

- The insulation of the Power Module and/or the motor is not adequate for the voltages that occur.
- There is no compatibility to an existing residual current device.
- The installation altitude is greater than 2000 m above sea level.
- A line filter should always be used for all systems that are not TN or TT systems with grounded neutral point.

An isolating transformer must have the following properties:

- The transformer must have a star connection on the secondary side.
- The neutral point must be brought out.

4.8 Line connection variants

Recommended vector group: Dyn5 or Yyn0

The neutral point must be grounded and connected to the protective conductor of the line filter or line reactor.

Remark: If the neutral point is not brought out and/or not connected, then all of the restrictions of an IT line system apply.

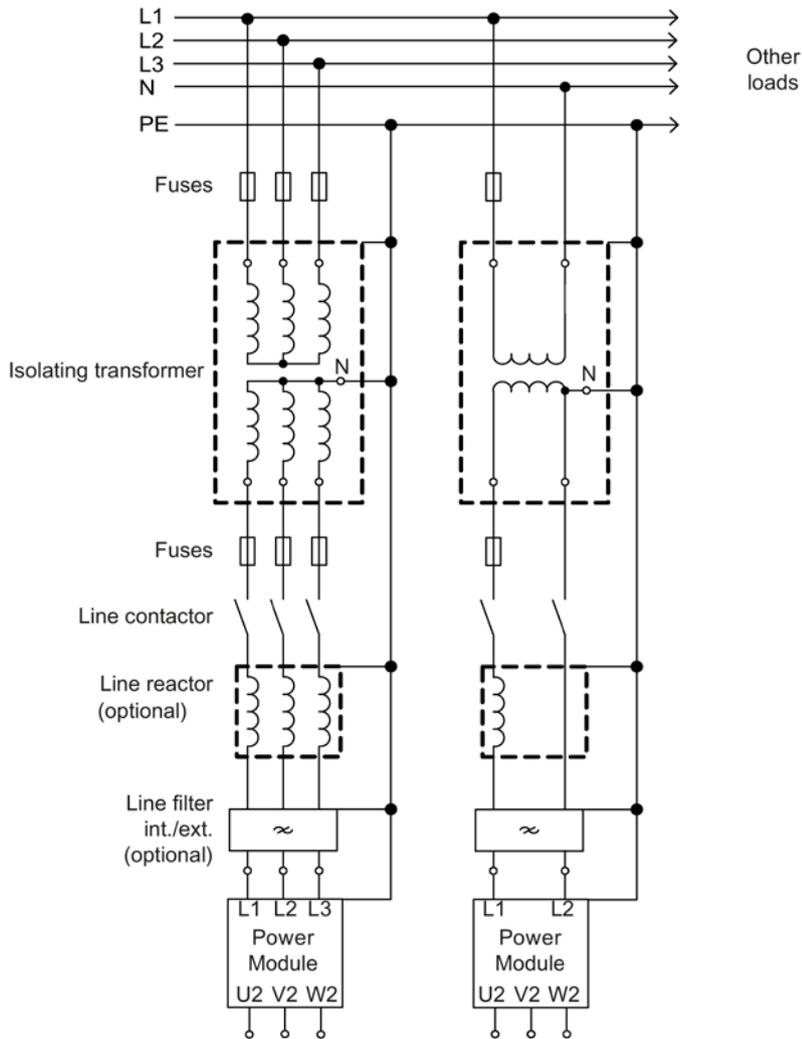


Figure 4-22 Connecting to the line supply using an isolating transformer

Power Modules

5.1 Safety instructions for Power Modules



WARNING

Electric shock when connecting an unsuitable power supply

If a power supply is connected that is not suitable, parts and components of the device could be live (under voltage). When touched, hazardous voltages at the housing can result in severe injury or death.

- Only use the intended supply voltage to operate the Power Modules.



WARNING

Electric shock caused by high leakage currents when the protective conductor in the line feeder cable is interrupted

Drive components conduct high discharge currents via the protective conductor. Touching conductive parts when the protective conductor is interrupted can result in death or serious injury.

- Carefully comply with the applicable regulations when dimensioning the protective conductor (Page 385).

Note

Fault protection when insulation fails in the motor circuit at the output side

In case of insulation failure in the motor circuit, the overcurrent trip meets the requirements of IEC 60364-4-41:2005/AMD1:2017 Section 411, Annex D for protection against electric shock.

- Observe the installation specifications provided in this manual.
- Ensure the continuity of the protective conductor.
- Observe the applicable installation standards.

Note

Malfunctions on non-Siemens equipment caused by high-frequency faults in residential environments

In the first environment, Category C2 according to EMC product standard IEC 61800-3 (residential, commercial and industrial sector), the device may cause high-frequency disturbance, which can result in malfunctions in other equipment.

- Have qualified personnel carry out the installation and commissioning with suitable interference suppression measures.

Note

For a UL-approved system use UL-approved cables only.

5.2 Blocksize Power Modules (PM240-2)

5.2.1 Description of PM240-2

A Power Module is a power unit (frequency converter) that provides the power supply for the connected motor. It must be connected with a Control Unit, in which its open-loop and closed-loop control functions are saved.

Power Modules are designed for single-motor drives without energy recovery into the line supply. Generated energy produced during braking is converted to heat in braking resistors.

Power Modules of the Blocksize format contain:

- Output inverter for the supply of a motor
- Braking chopper for (external) braking resistor
- 24 VDC / 1 A power supply
- Fan to cool the power semiconductors
- PM240-2 Power Modules FSD to FSG have integrated DC link reactors and therefore do not need a line reactor.

The FSA to FSF Power Modules cover the power range from 0.55 kW to 132 kW and are available in versions with and without a line filter.

Power Modules FSG have a power range from 160 kW up to 250 kW. They are equipped with a line filter:

- 400 V devices: either C2 or C3 filter
- 690 V devices: C3 filter

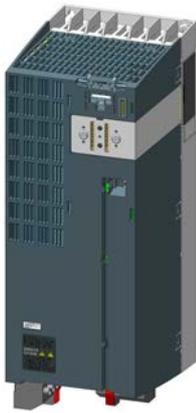
The PM240-2 Power Modules are designed for installation in the cabinet and in the following cooling variants:

- Built-in unit with internal air cooling
- Push-through device with external air cooling (exception, FSG)

Table 5- 1 Overview of PM240-2 Power Modules (frame size/power)

Frame size	Power in kW					
	200-240 V	200-240 V PT	380-480 V	380-480 V PT	500-690 V	500-690 V PT
FSA	0.55 - 0.75	0.75	0.55 - 3	3	-	-
FSB	1.1 - 2.2	2.2	4 - 7.5	7.5	7.5	-
FSC	3 - 7.5	7.5	11 - 15	15	-	-
FSD	11 - 18.5	18.5	18.5 - 37	37	11 - 37	-
FSE	22 - 30	30	45 - 55	55	45 - 55	-
FSF	37 - 55	55	75 - 132	132	75 - 132	-
FSG	-	-	160 - 250	-	160 - 250	-

Table 5- 2 Overview of PM240-2 Power Modules (FSA to FSG)

	
<p>Power Module frame size FSA, with and without line filter</p>	<p>Push through Power Module frame size FSA, with and without line filter</p>
	
<p>Power Module frame size FSB, with and without line filter</p>	<p>Push through Power Module frame size FSB, with and without line filter</p>
	
<p>Power Module frame size FSC, with and without line filter</p>	<p>Push through Power Module frame size FSC, with and without line filter</p>

	
<p>Power Module frame size FSD, with and without line filter¹⁾</p>	<p>Power Module Push Through frame size FSD, with and without line filter¹⁾</p>
	
<p>Power Module frame size FSE, with and without line filter¹⁾</p>	<p>Power Module Push Through frame size FSE, with and without line filter¹⁾</p>

	
<p>Power Module frame size FSF, with and without line filter¹⁾</p>	<p>Power Module Push Through frame size FSF, with and without line filter¹⁾</p>
	
<p>Power Modules frame size FSG, with integrated C2/C3 line filter²⁾</p>	

¹⁾ PM240-2, FSD to FSF, 200-240 V are only available without integrated line filter.

²⁾ PM240-2, FSG 380-480 V are available with C2 or C3 filters; FSG 500-690 V are only available with C3 filters.

5.2.2 Requirements for UL/cUL/CSA

Power Modules for plants and systems in the United States / Canada (UL/cUL)

- For a system configuration in conformance with UL/cUL, use the fuse types or circuit breakers approved for UL/cUL specified in Chapter "Overcurrent protection using line fuses and circuit breakers (Page 47)".
- The integrated semiconductor short-circuit protection does not provide cable protection.
- On the system side, provide cable protection in conformance with NEC or CEC, Part 1 and the local regulations.
- The Power Module is equipped with internal motor overload protection corresponding to UL 61800-5-1. Protection threshold:
 - 115% of the rated motor current entered for frame sizes FSA ... FSF
 - 120% of the rated motor current entered for frame size FSG

You enter the motor data values and the protection functions when commissioning the Power Modules. Please observe the details in the associated operating instructions.

- For frame sizes FSF and FSG, to connect the line supply and motors only use UL-approved ring-type cable lugs (ZMVV), which are certified for the particular voltage, with a permissible current of at least 125 % of the input and output current. Use the higher value as basis.
- Carefully note that for plants and systems in conformance with UL/cUL, the line and output voltage may not be higher than 600 V.
- FSA ... FSC: Only use copper cables rated for 75 °C.
- FSD ... FSG: Only use copper cables rated for 60 °C or 75 °C.
- The Power Modules are open-type devices.
- Power Modules FSD ... FSF in a push-through version are open-type devices. Toward the rear control cabinet panel, they comply with Enclosure Type 1.

Additional requirements for CSA compliance, frame sizes FSA ... FSC

Install the Power Module with an external interference suppression device with the following properties:

- Surge protection device with the appropriate certification (category checking numbers VZCA and VZCA7)
- Rated supply voltage
 - 240 V (phase with respect to ground), 240 V (phase to phase) for 200 V Power Modules
 - 480 V (phase to phase) for 400 V Power Modules
- Terminal voltage, V_{PR}
 - Max. 2 kV for 200 V Power Modules
 - Max. 2.5 kV for 400 V Power Modules
- Overvoltage category III
- Pollution degree 2
- Suitable for SPD applications, type 1 or type 2 (SPD = Surge Protective Device)

Additional requirements relating to CSA conformance, frame sizes FSD ... FSG

Overvoltage category OVC III must be ensured for all connections of the power circuit. This can mean that a surge suppressor must be connected upstream on the line side (SPD = surge protective device). The rated voltage of the surge suppressor must not lie below the line voltage, and must guarantee the limit values V_{PR} (V_{PR} = Voltage Protection Rating = terminal voltage).

Line voltage	Grounding	Phase to ground		Phase to phase	
		Rated voltage	V_{PR}	Rated voltage	V_{PR}
3 AC 200 V ... 240 V	Grounded neutral conductor	139 V	2.5 kV	240 V	4 kV
	Grounded line conductor	240 V	4 kV	240 V	4 kV
3 AC 380 V ... 480 V	Grounded neutral conductor	277 V	4 kV	480 V	4 kV
	Grounded line conductor	480 V	6 kV	480 V	4 kV
3 AC 500 V ... 600 V	Grounded neutral conductor	347 V	6 kV	600 V	4 kV
	Grounded line conductor	600 V	6 kV	600 V	4 kV

5.2.3 Interface description

5.2.3.1 Overview

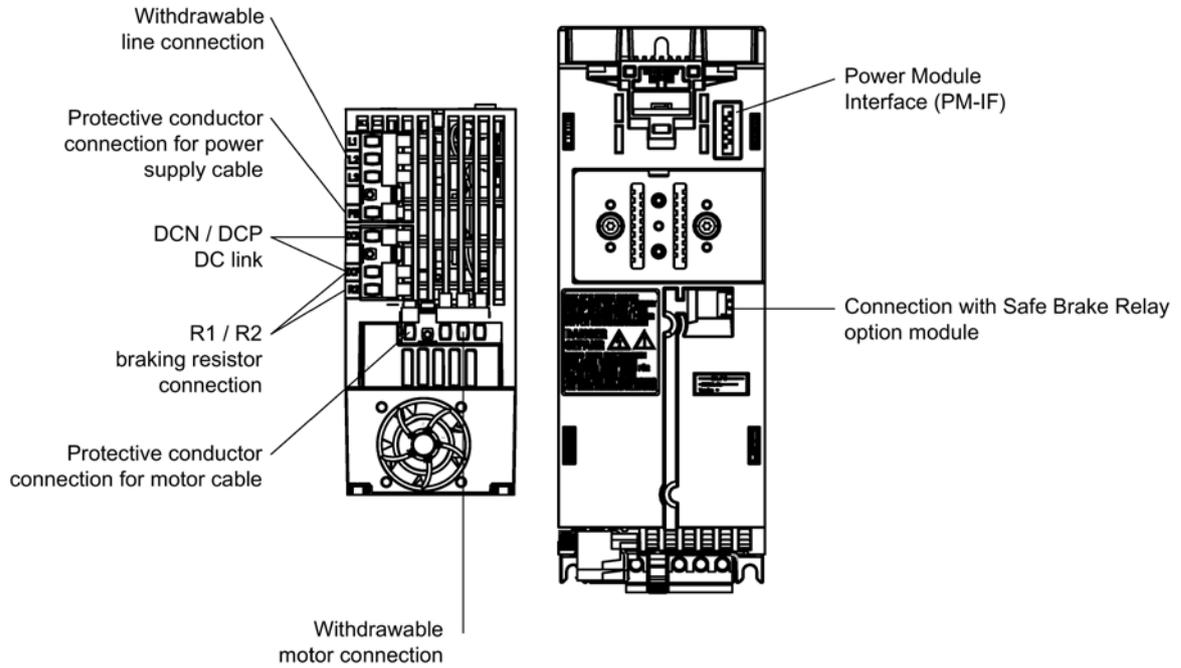


Figure 5-1 PM240-2, frame size FSA (view from below and front)

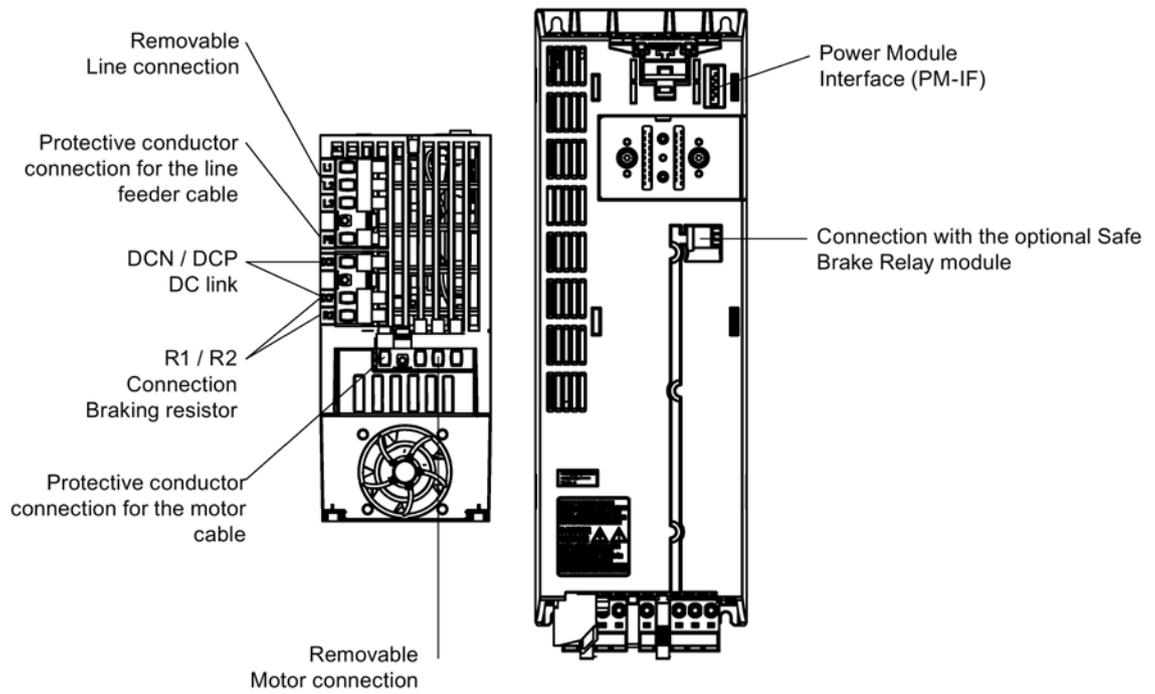


Figure 5-2 PM240-2, frame size FSB (view from below and front)

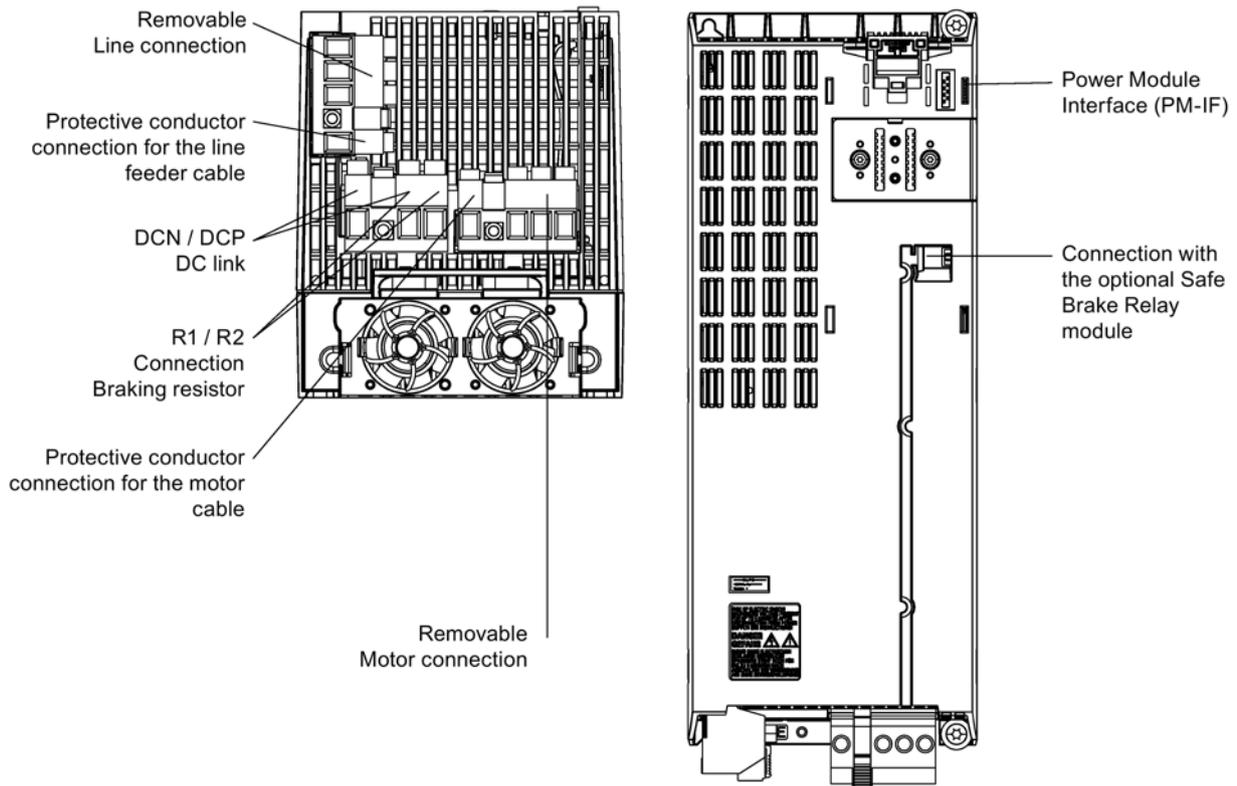


Figure 5-3 PM240-2, frame size FSC (view from below and front)

5.2 Blocksize Power Modules (PM240-2)

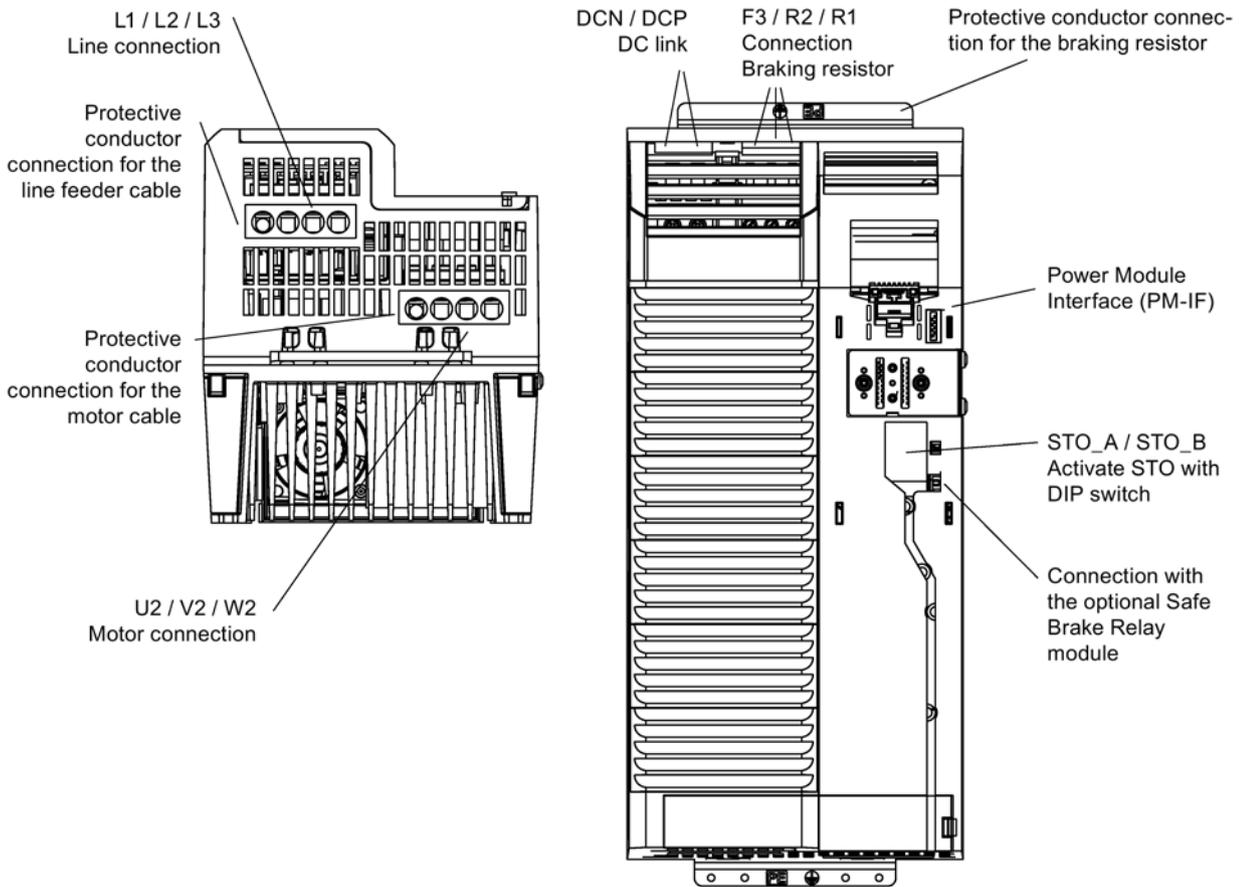


Figure 5-4 PM240-2, frame size FSD (view from below and front)

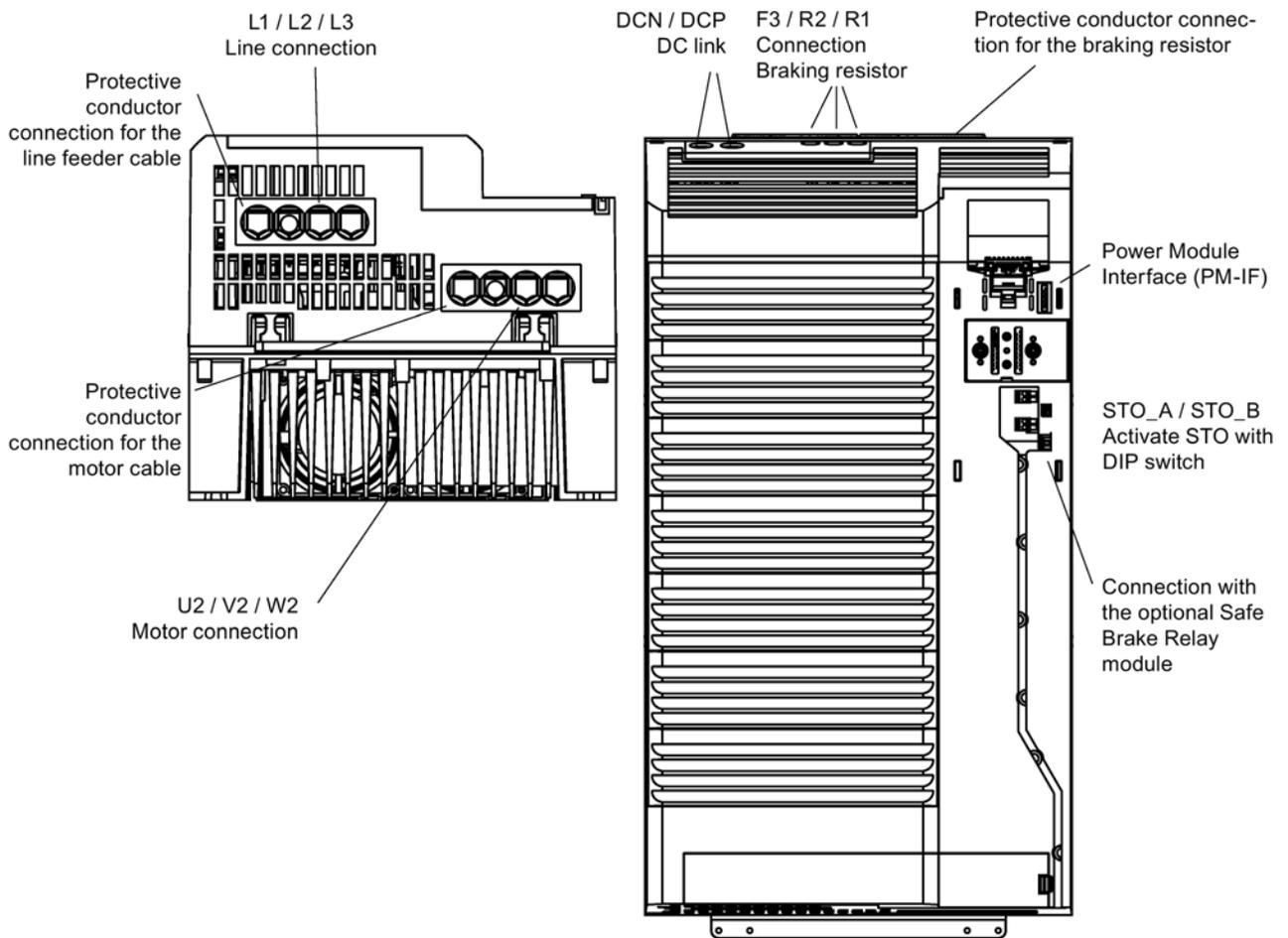


Figure 5-5 PM240-2, frame size FSE (view from below and front)

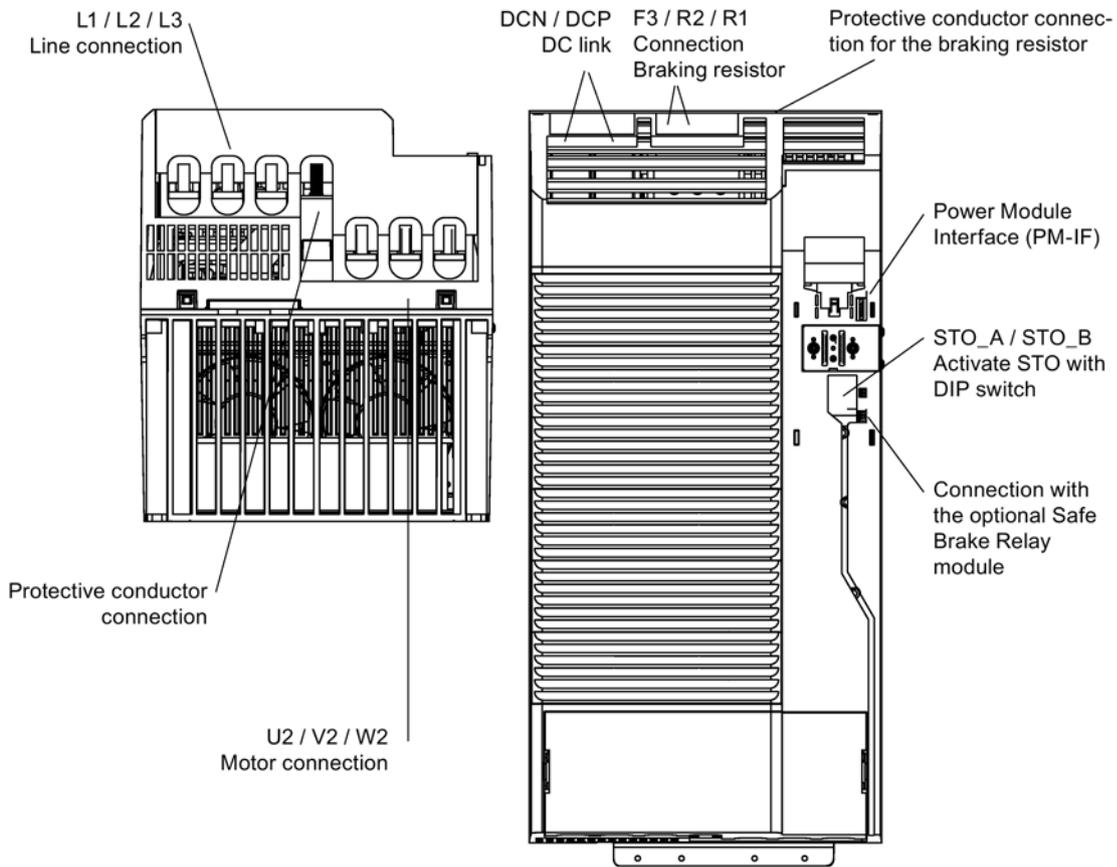


Figure 5-6 PM240-2, frame size FSF (view from below and front)

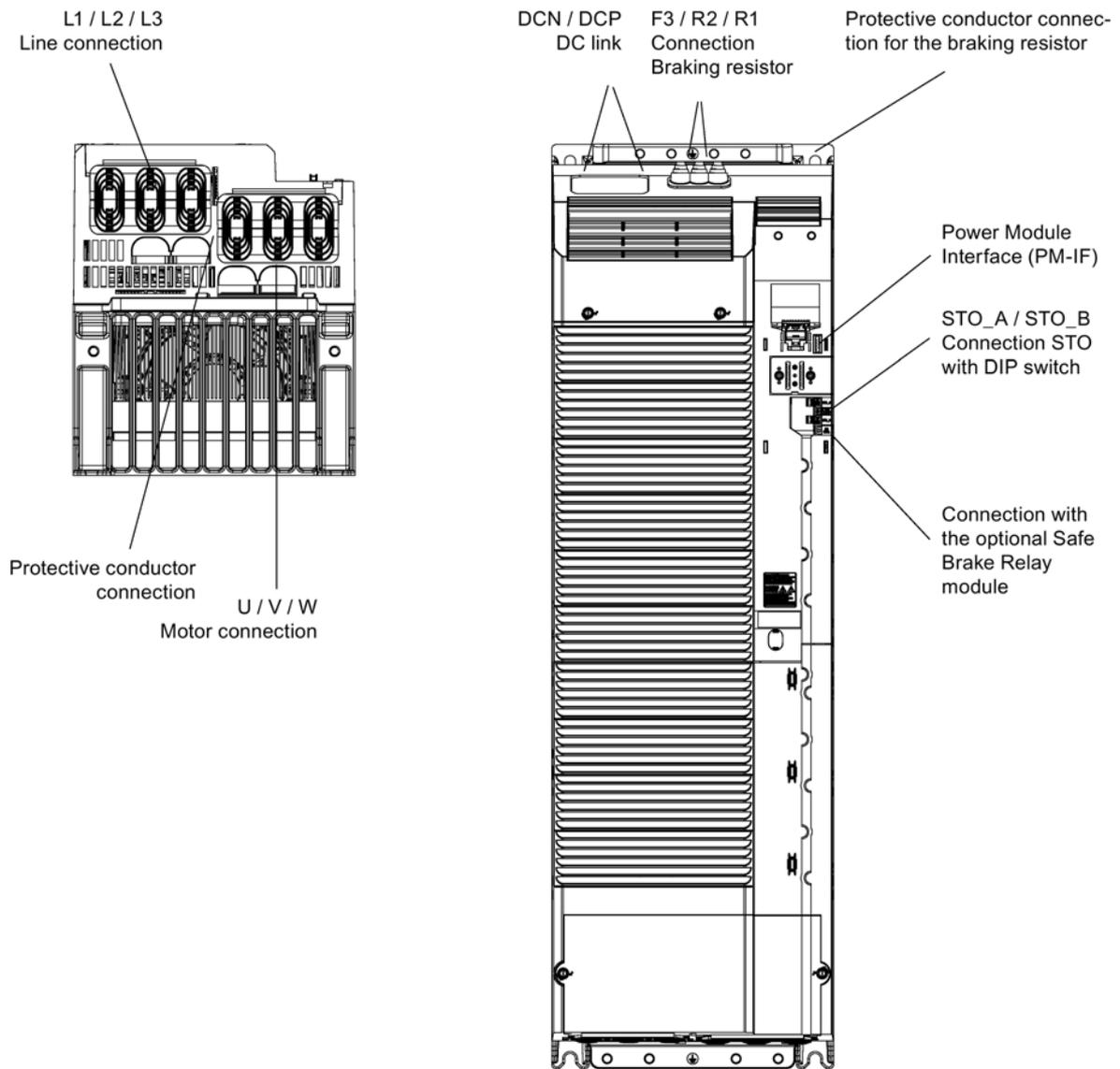
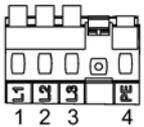


Figure 5-7 PM240-2, frame size FSG (view from below and front)

5.2.3.2 Line supply connection

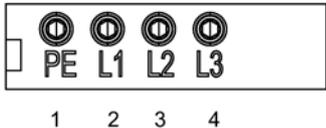
Power Modules PM240-2: FSA, FSB, and FSC

Table 5- 3 Removable line connector

	Terminal	Signal name	Technical data
	1	L1	Line conductor L1
	2	L2	Line conductor L2
	3	L3	Line conductor L3
	4		Protective conductor connection

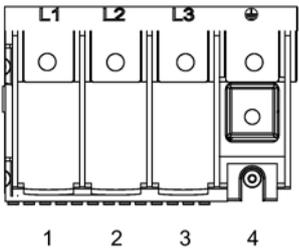
Power Modules PM240-2: FSD and FSE

Table 5- 4 Line supply connection terminal

	Terminals	Signal name	Technical data
	1	PE	Protective conductor connection
	2	L1	Line conductor L1
	3	L2	Line conductor L2
	4	L3	Line conductor L3

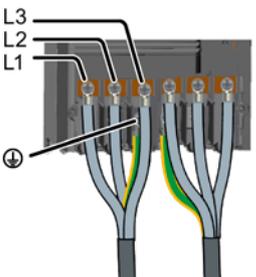
Power Modules PM240-2: FSF

Table 5- 5 Line supply connection terminal

	Terminals	Signal name	Technical data
	1	L1	Line conductor L1
	2	L2	Line conductor L2
	3	L3	Line conductor L3
	4		Protective conductor connection

Power Modules PM240-2: FSG

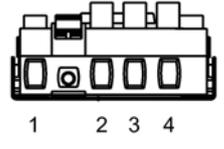
Table 5- 6 Line connection

	Signal name	Technical data
	L1	Line conductor L1
	L2	Line conductor L2
	L3	Line conductor L3
	⊕	Protective conductor connection

5.2.3.3 Motor connection

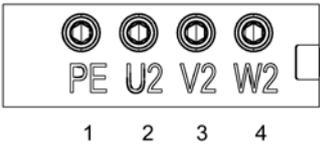
Power Modules PM240-2: FSA, FSB, and FSC

Table 5- 7 Removable motor connector

	Terminal	Signal name	Technical data
	1	⊕	Protective conductor connection
	2	U2	Motor phase U
	3	V2	Motor phase V
	4	W2	Motor phase W

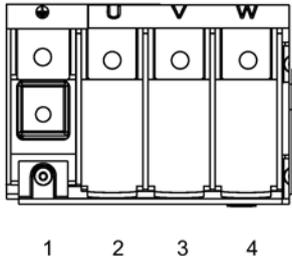
Power Modules PM240-2: FSD and FSE

Table 5- 8 Motor terminals

	Terminal	Signal name	Technical data
	1	PE	Protective conductor connection
	2	U2	Motor phase U
	3	V2	Motor phase V
	4	W2	Motor phase W

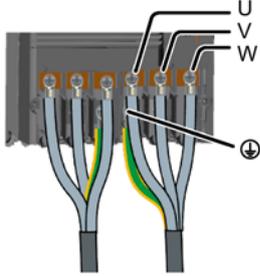
Power Modules PM240-2: FSF

Table 5- 9 Motor terminals

	Terminal	Signal name	Technical data
	1	⏚	Protective conductor connection
	2	U	Motor phase U
	3	V	Motor phase V
	4	W	Motor phase W

Power Modules PM240-2: FSG

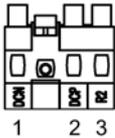
Table 5- 10 Motor connection

	Signal name	Technical data
	⏚	Protective conductor connection
	U	Motor phase U
	V	Motor phase V
	W	Motor phase W

5.2.3.4 Braking resistor and DC link connection

Power Modules PM240-2: FSA, FSB, and FSC

Table 5- 11 Removable braking resistor and DC link connector

	Terminal	Signal name	Technical data
	1	DCN	DC link negative
	2	DCP/R1	DC link positive and positive connection for braking resistor
	3	R2	Negative connection for the braking resistor

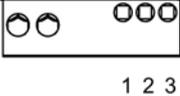
Power Modules PM240-2: FSD

Table 5- 12 Braking resistor terminals

	Terminal	Signal name	Technical data
	1	F3	Reserved - do not use
	2	R2	Negative connection for the braking resistor
	3	R1	Positive connection for the braking resistor

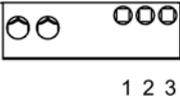
Power Modules PM240-2: FSE

Table 5- 13 Braking resistor terminals

	Terminal	Signal name	Technical data
	1	F3	Reserved - do not use
	2	R2	Negative connection for the braking resistor
	3	R1	Positive connection for the braking resistor

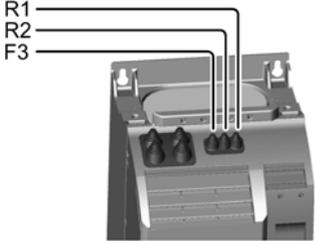
Power Modules PM240-2: FSF

Table 5- 14 Braking resistor terminals

	Terminal	Signal name	Technical data
	1	F3	Reserved - do not use
	2	R2	Negative connection for the braking resistor
	3	R1	Positive connection for the braking resistor

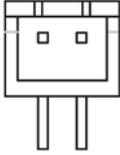
Power Modules PM240-2: FSG

Table 5- 15 Braking resistor connection

	Signal name	Technical data
	R1	Positive connection for the braking resistor
	R2	Negative connection for the braking resistor
	F3	Reserved - do not use

5.2.3.5 Safe brake relay connection

Table 5- 16 Connector

	Terminal	Designation	Technical data
	1	Low	Low signal Safe Brake Relay to PM240-2
	2	High	High signal Safe Brake Relay to PM240-2

Note

For additional information, see Section "Option module Safe Brake Relay (Page 338)".

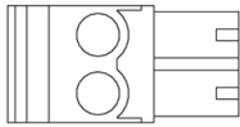
5.2.3.6 STO via Power Module terminals

PM240-2 Power Modules, FSD to FSG

The Safe Torque Off (STO) safety function is used to safely disconnect the power feed to the motor that generates the torque.

Using PM terminals - STO_A and STO_B - as well as 2 DIP switches, the "Safe Torque Off" (STO) function can be used independent of a Control Unit using the Power Module hardware. This hardware-based STO can be used up to PL e according to EN 13849-1 and SIL3 according to IEC 61508 with the appropriate application engineering.

Table 5- 17 Terminals STO_A/STO_B for the safety function "Safe Torque Off"

	Terminal	Signal name	Technical data
	1	STO_A/STO_B	Voltage: 24 V DC (20.4 to 28.8 V) Current consumption: Max. 1.0 A
	2	M	Ground
Type: Screw terminal 2 (Page 384)			

Note

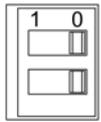
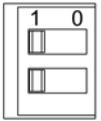
Using the "STO" safety function via the Power Module terminals

With enabled Safety Integrated Functions of the CU310, a **simultaneously active** STO function via Power Module terminals results in fault messages being output.

Note**Insulated signal cables**

Signal cables that are routed in the cable duct with 600 V power cables must be insulated.

Table 5- 18 DIP switches for the safety function "Safe Torque Off" via terminals of the Power Module

DIP switch	Application
	To use Safety Integrated of the CU310, deactivate the function "STO via Power Module terminals" by setting both the DIP switches for the interface STO_A/STO_B into the "0" position.
	To enable the "Safe Torque Off" safety function via Power Module terminals, you must set both DIP switches to the "1" position.

Note**Diagnostics**

The state of the switch-off signal paths can be monitored using 2 digital outputs of the Control Unit. You can find additional information in the SINAMICS S120/S150 List Manual.

Note**Conformity with SIL3**

To satisfy the requirements of SIL3, you must regularly check the STO functionality – as a minimum every 4 weeks. The check must be made on the plant/system side.

5.2.4 Connection example

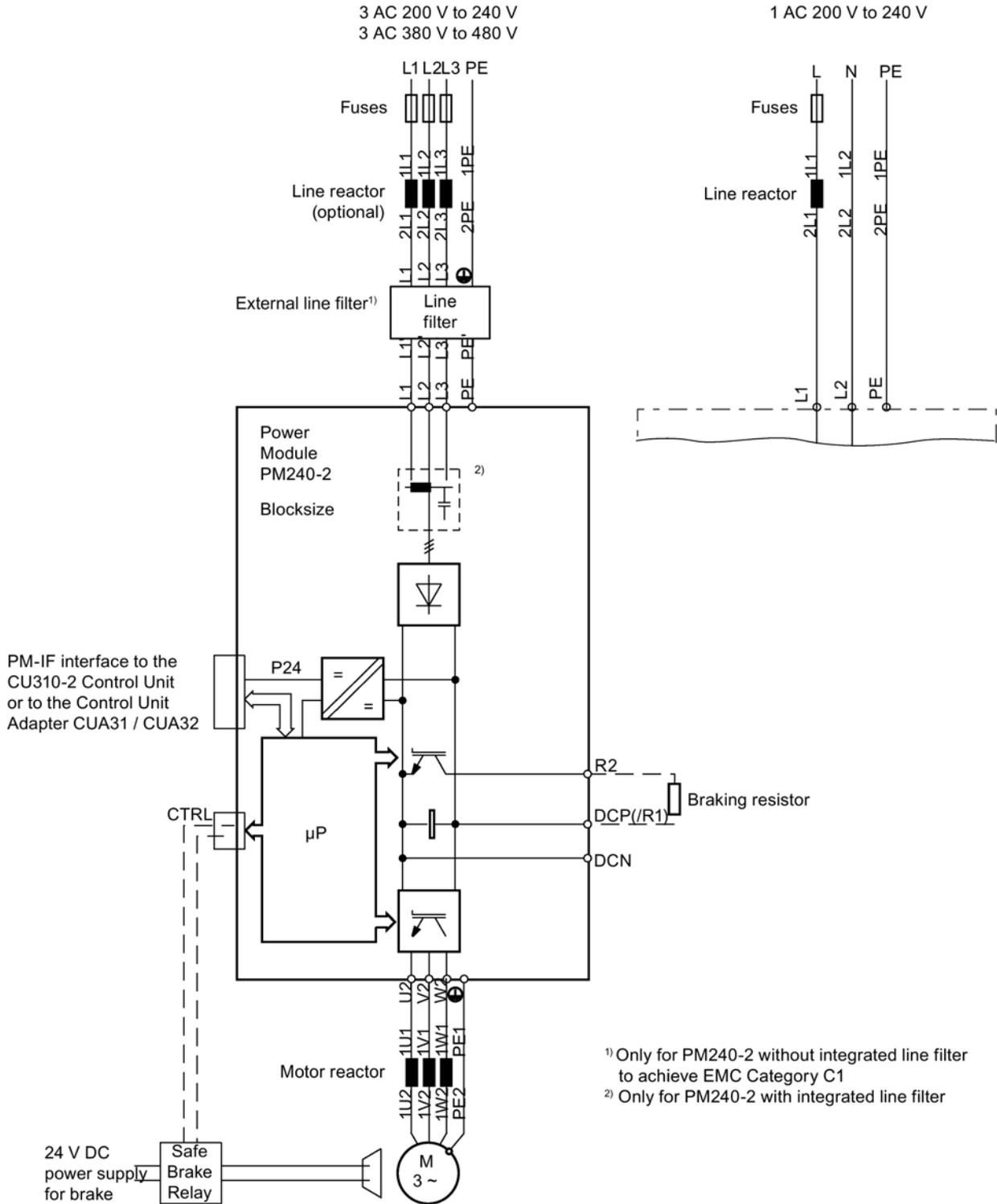


Figure 5-8 Connection example, Power Modules PM240-2, FSA-FSC

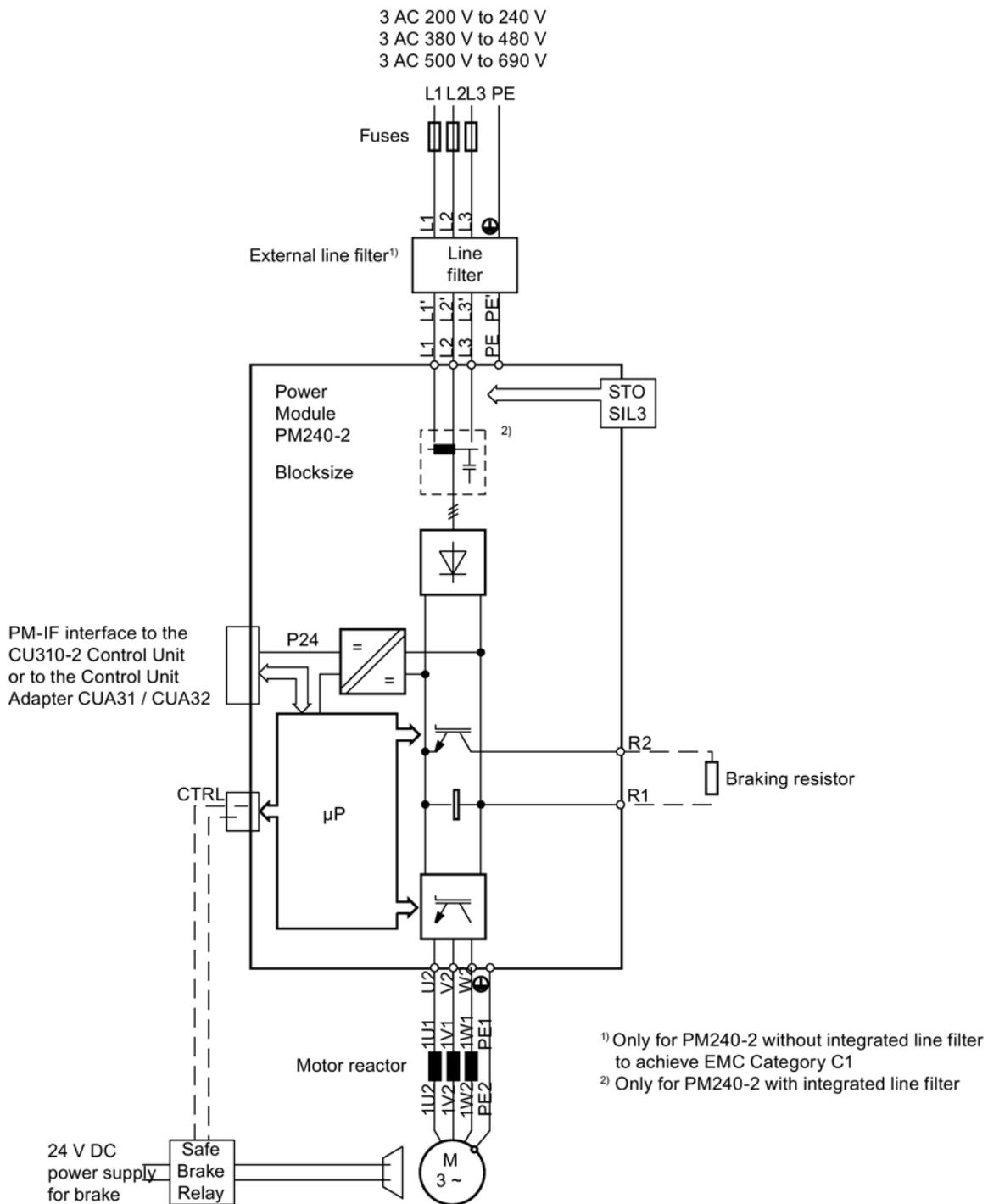


Figure 5-9 Connection example, Power Modules PM240-2, FSD-FSG

5.2.5 Dimension drawings

5.2.5.1 Power Modules with internal cooling

Dimension drawings of the Power Modules

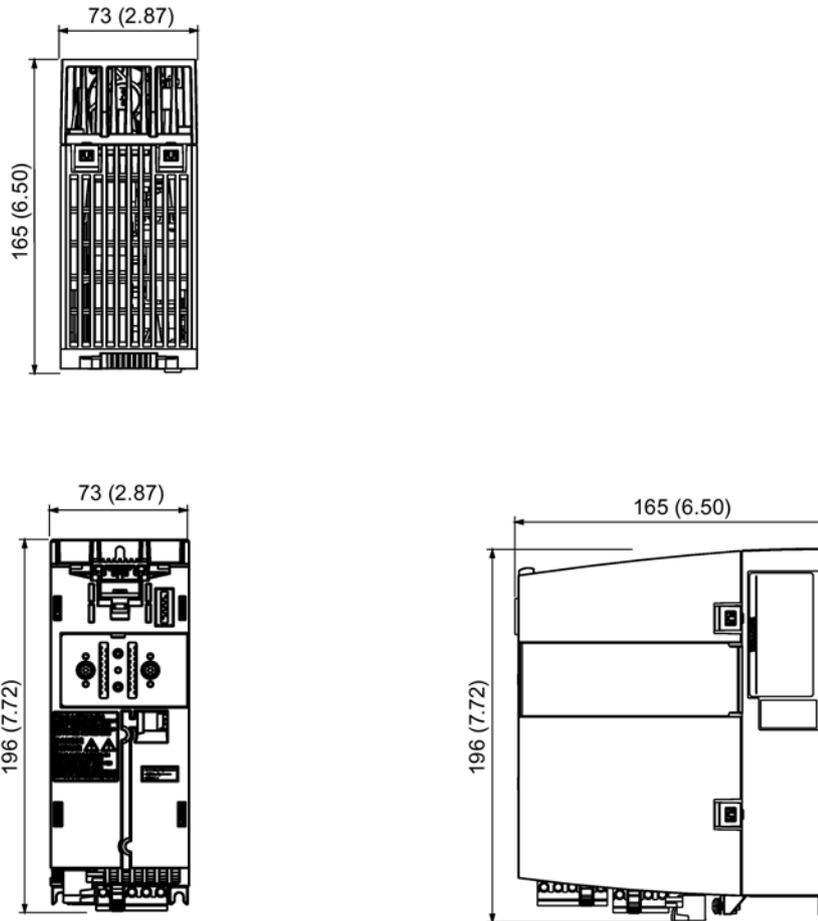


Figure 5-10 Dimension drawing of PM240-2 Power Modules, frame size FSA, all data in mm (inches)

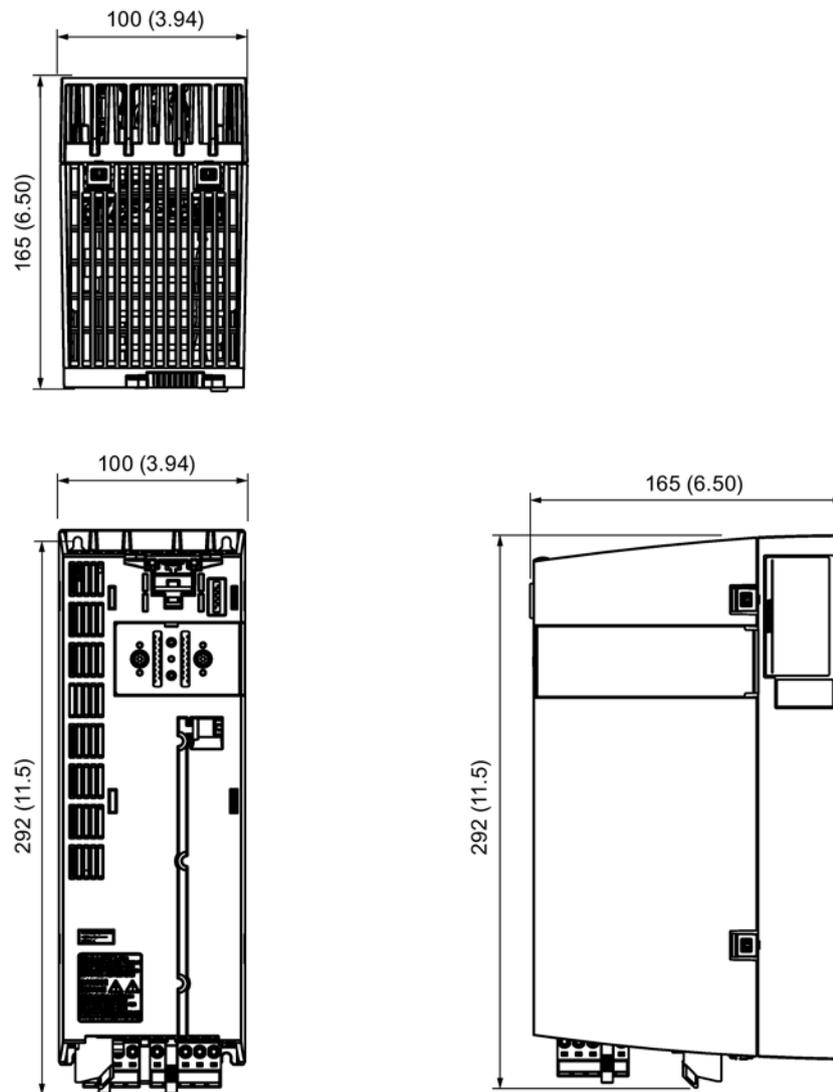


Figure 5-11 Dimension drawing of PM240-2 Power Modules, frame size FSB, all data in mm (inches)

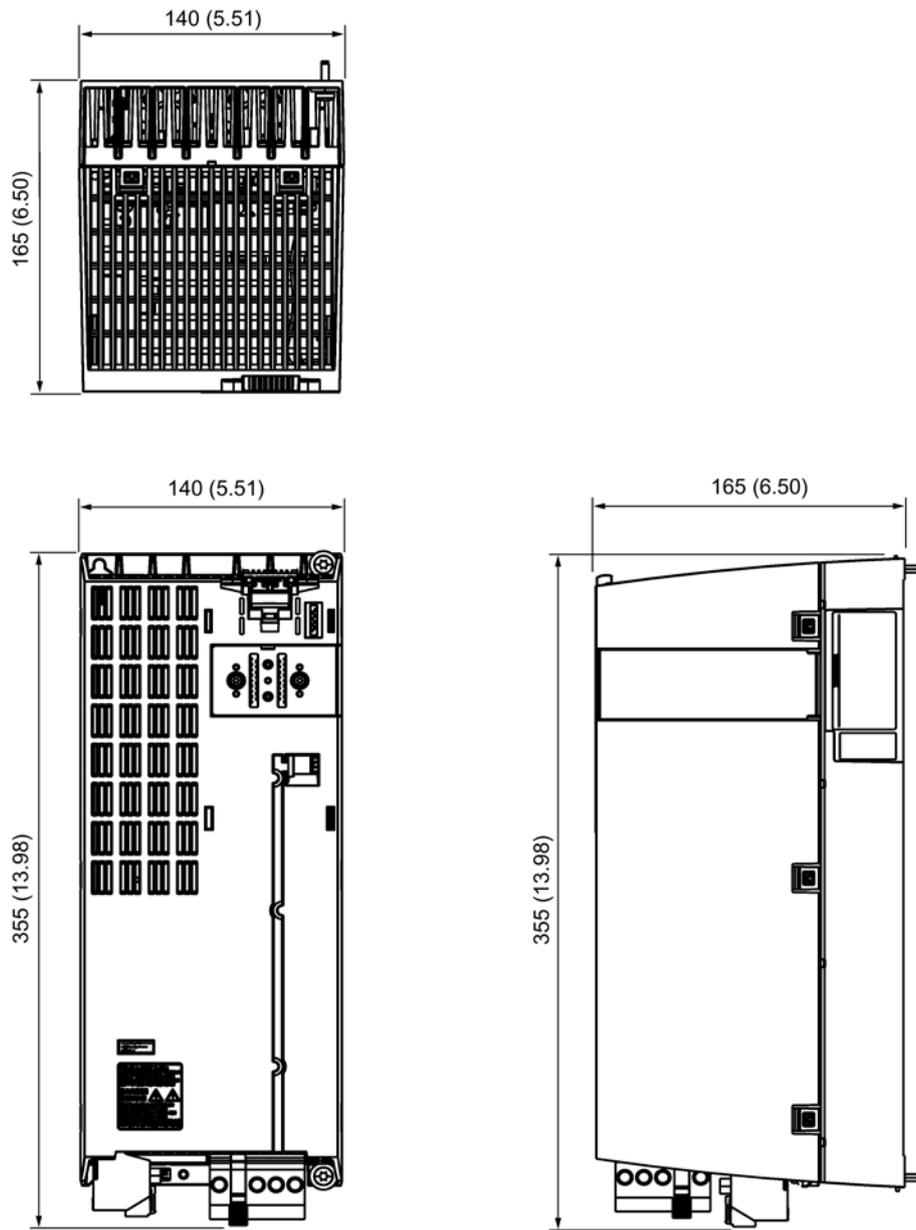


Figure 5-12 Dimension drawing of PM240-2 Power Modules, frame size FSC, all data in mm (inches)

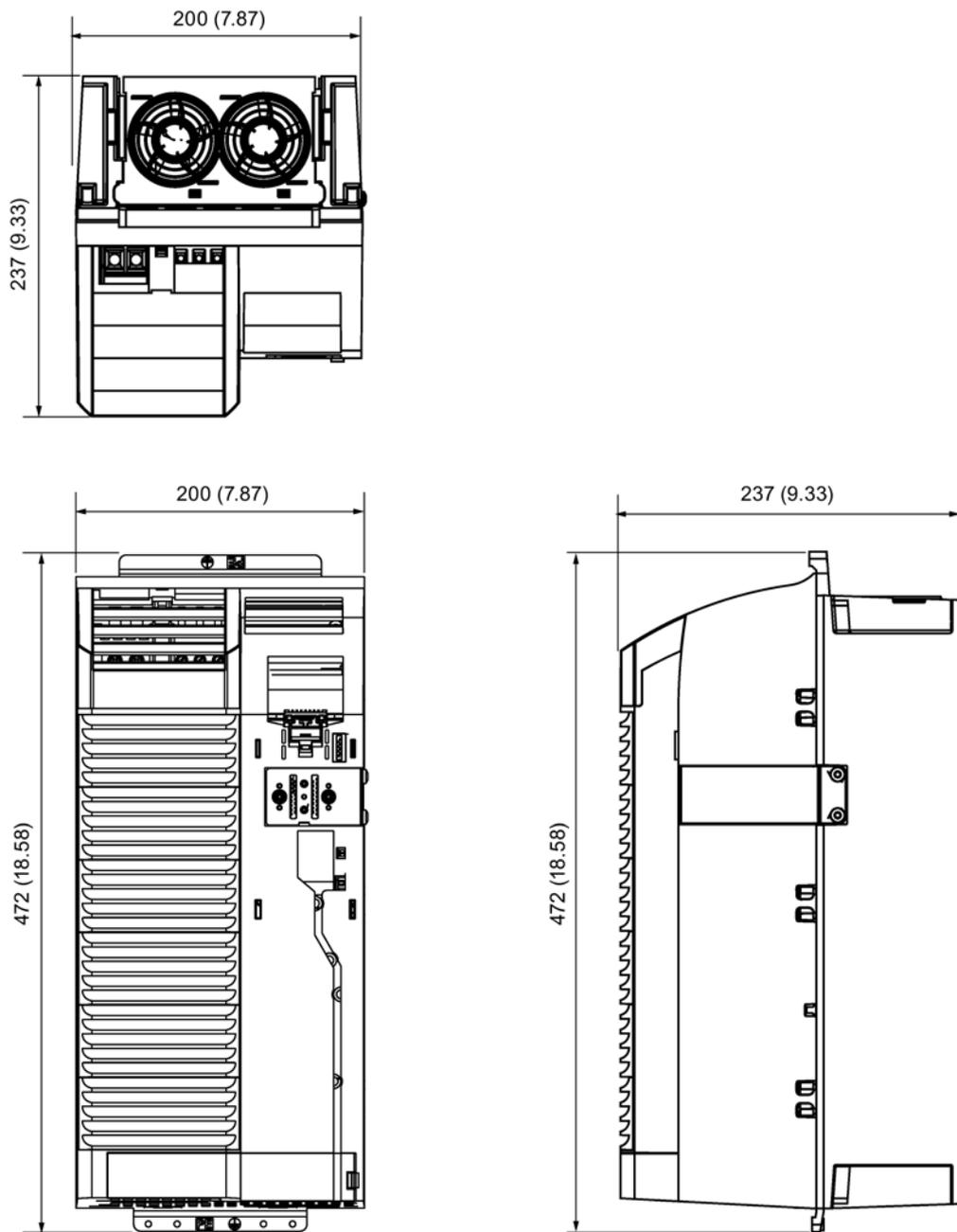


Figure 5-13 Dimension drawing of PM240-2 Power Modules, frame size FSD, all data in mm (inches)

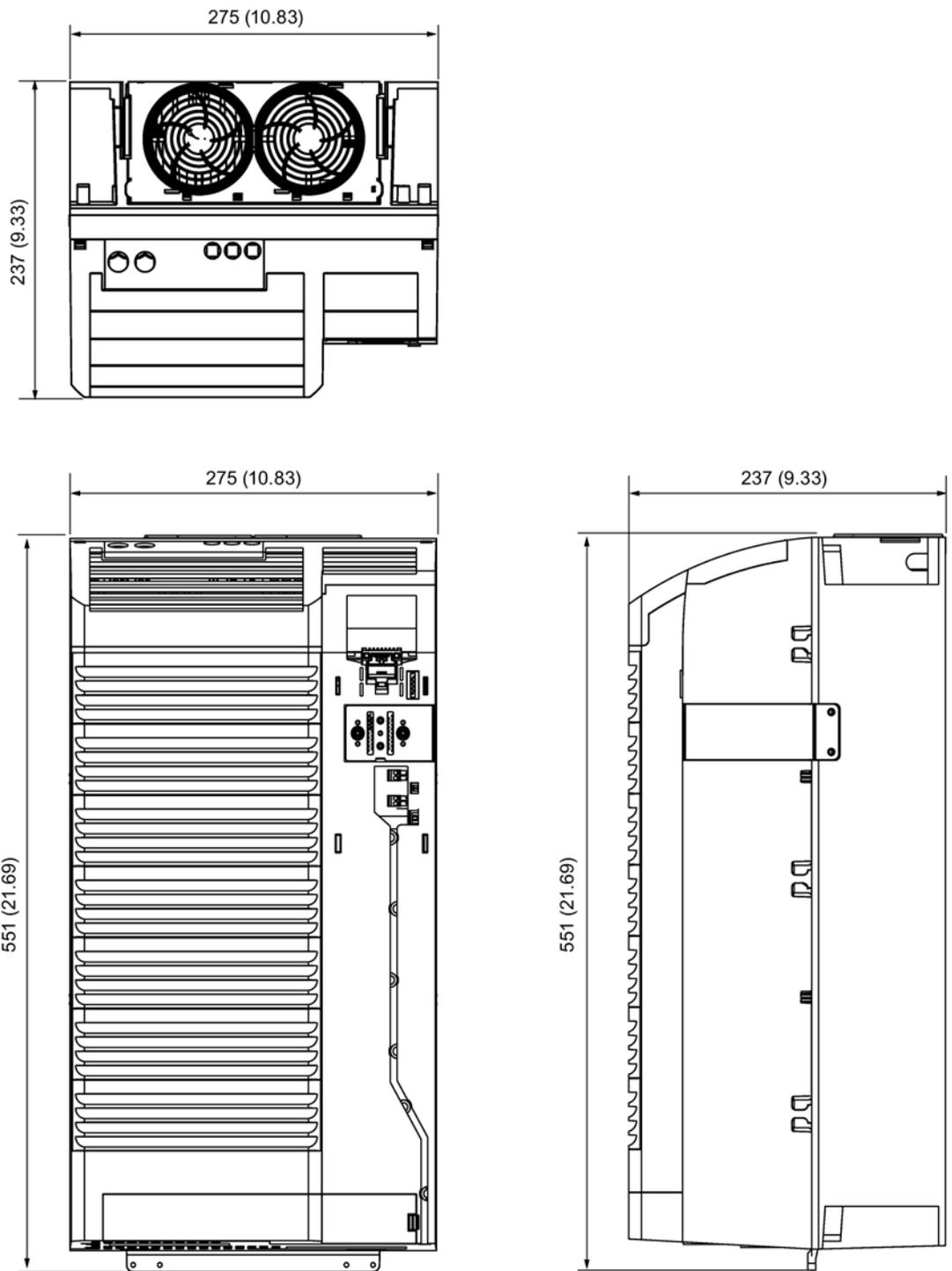


Figure 5-14 Dimension drawing of PM240-2 Power Modules, frame size FSE, all data in mm (inches)

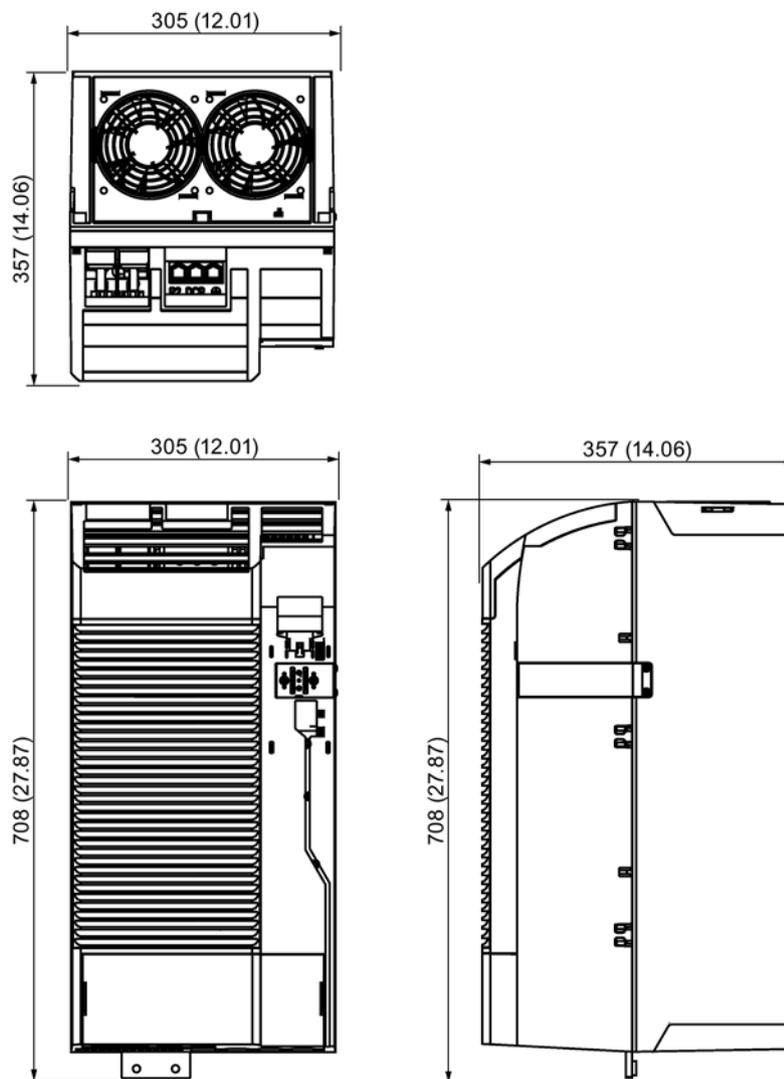


Figure 5-15 Dimension drawing of PM240-2 Power Modules, frame size FSF, all data in mm (inches)

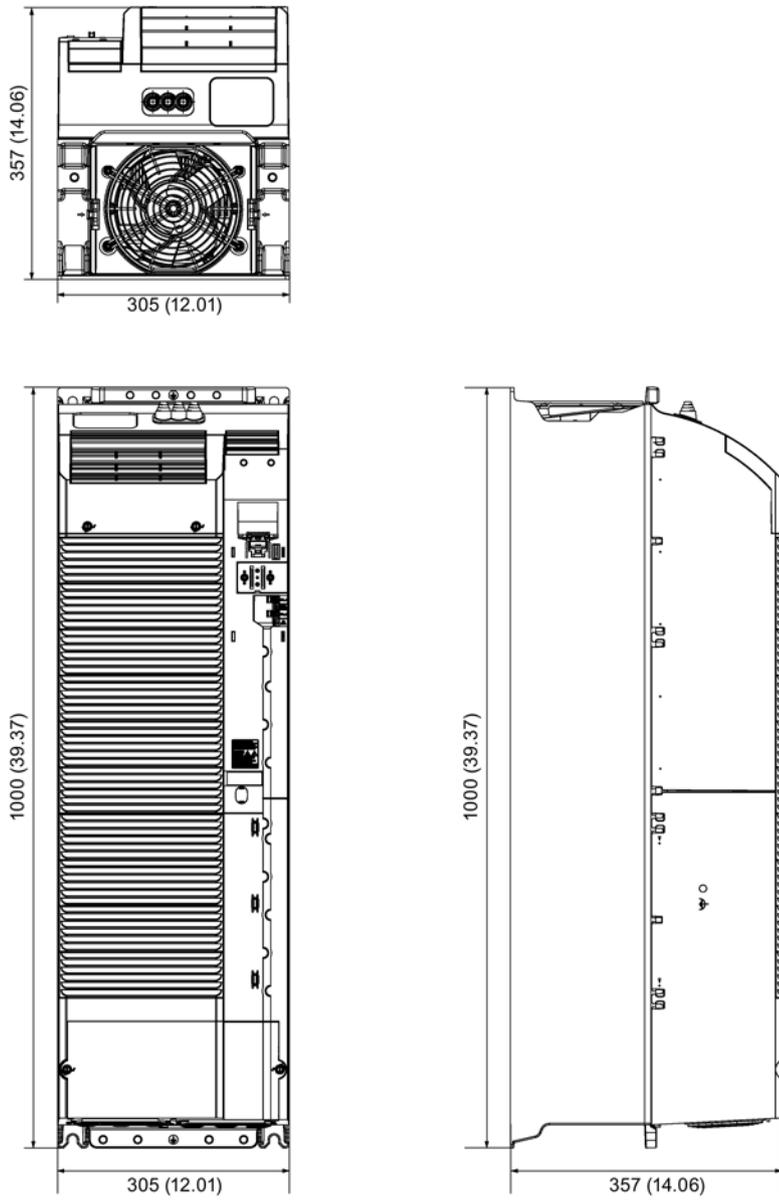


Figure 5-16 Dimension drawing of PM240-2 Power Modules, frame size FSG, all data in mm (inches)

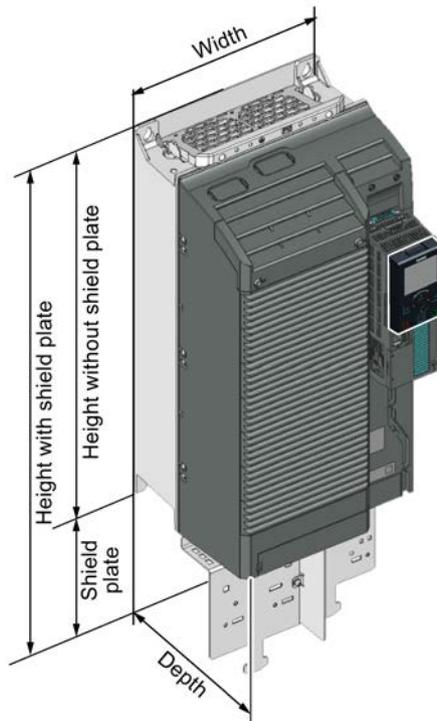


Figure 5-17 PM240-2, FSA-FSG dimensions

Table 5- 19 Dimensions of PM240-2 Power Modules, FSA-FSG

Frame size	Width in mm (inch)	Height in mm (inch)		Depth in mm (inch)
		without shield plate	with shield plate	
FSA	73 (2.87)	196 (7.72)	276 (10.87)	165 (6.50)
FSB	100 (3.94)	292 (11.50)	370 (14.57)	
FSC	140 (5.51)	355 (13.98)	432 (17.01)	
FSD	200 (7.87)	472 (18.58)	624 (24.57)	237 (9.33)
FSE	275 (10.83)	551 (21.69)	728 (28.66)	
FSF	305 (12.01)	708 (27.87)	966 (38.03)	357 (14.06)
FSG	305 (12.01)	1000 (39.37)	1257 (49.49)	

5.2.5.2 Push through Power Modules

Dimension drawings of the Power Modules

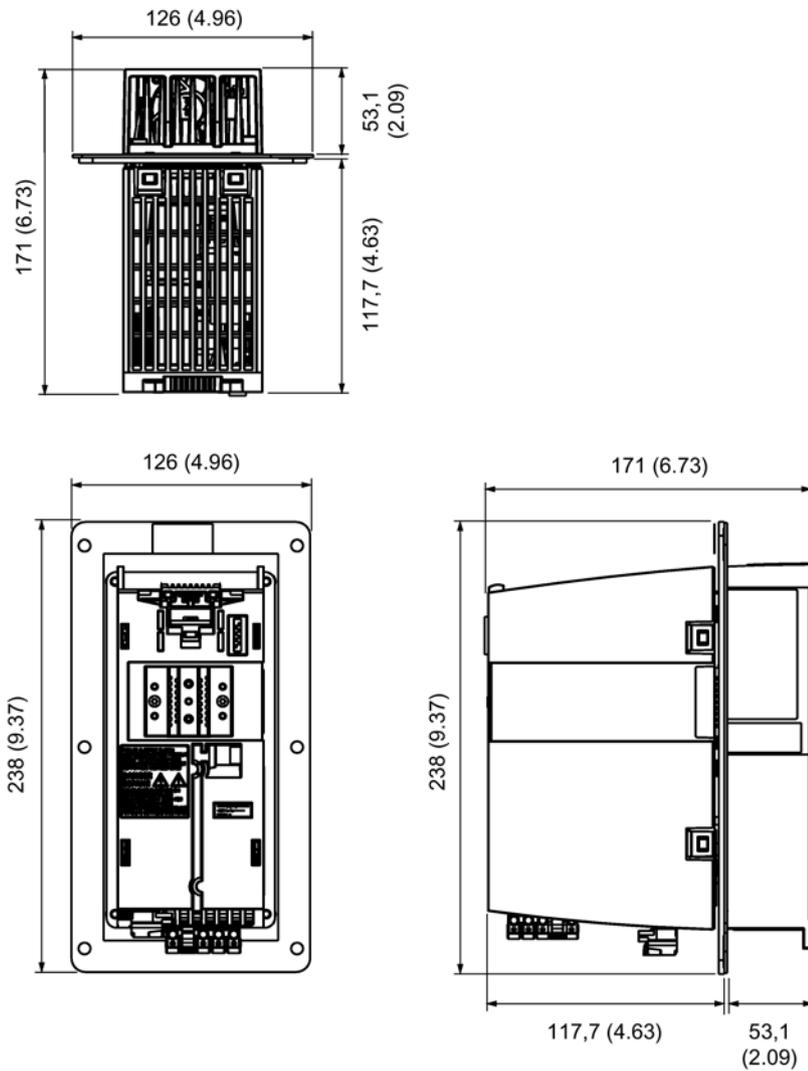


Figure 5-18 Dimension drawing of PM240-2 Push Through Power Modules, frame size FSA, all data in mm (inches)

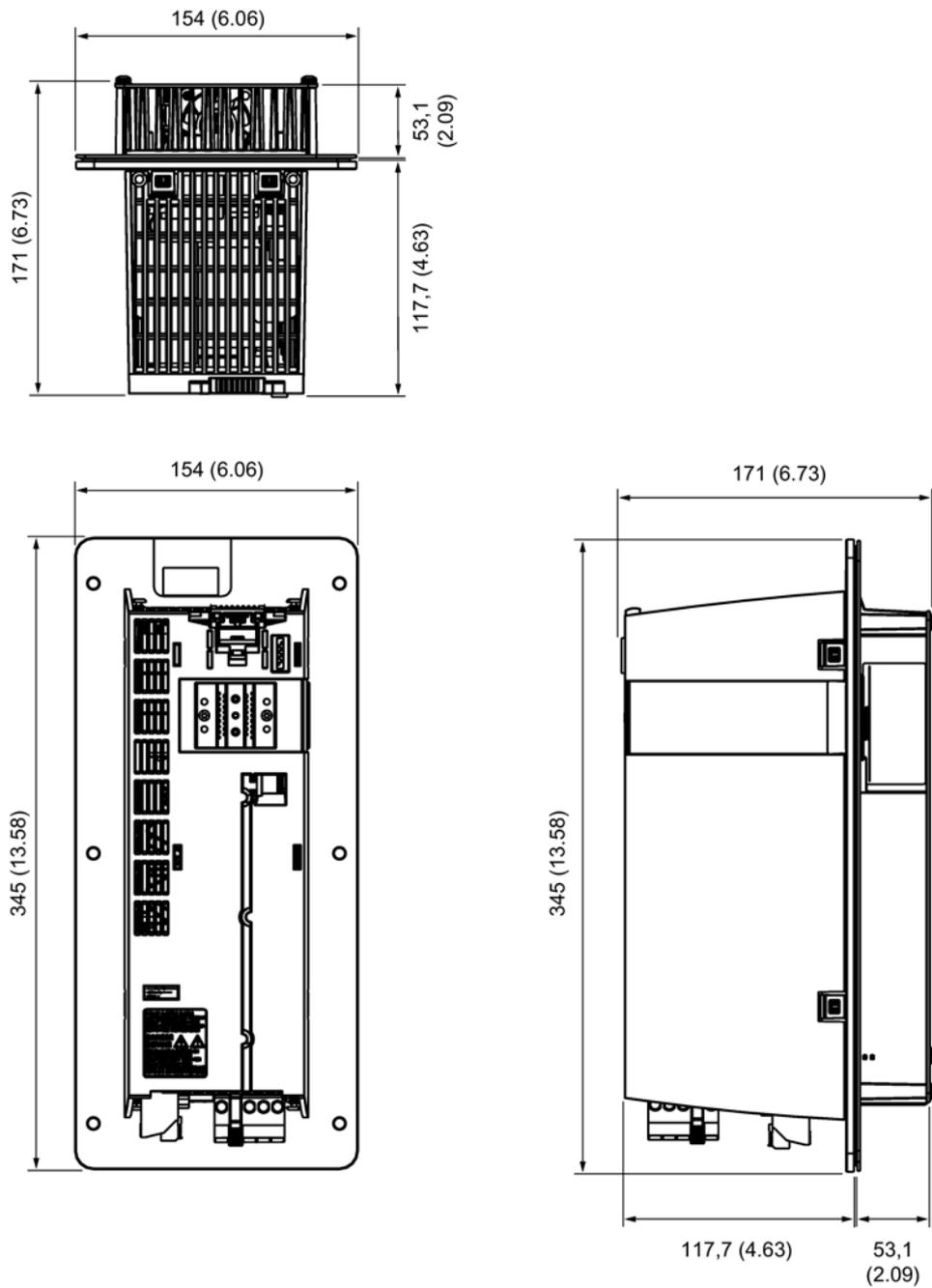


Figure 5-19 Dimension drawing of PM240-2 Push Through Power Modules, frame size FSB, all data in mm (inches)

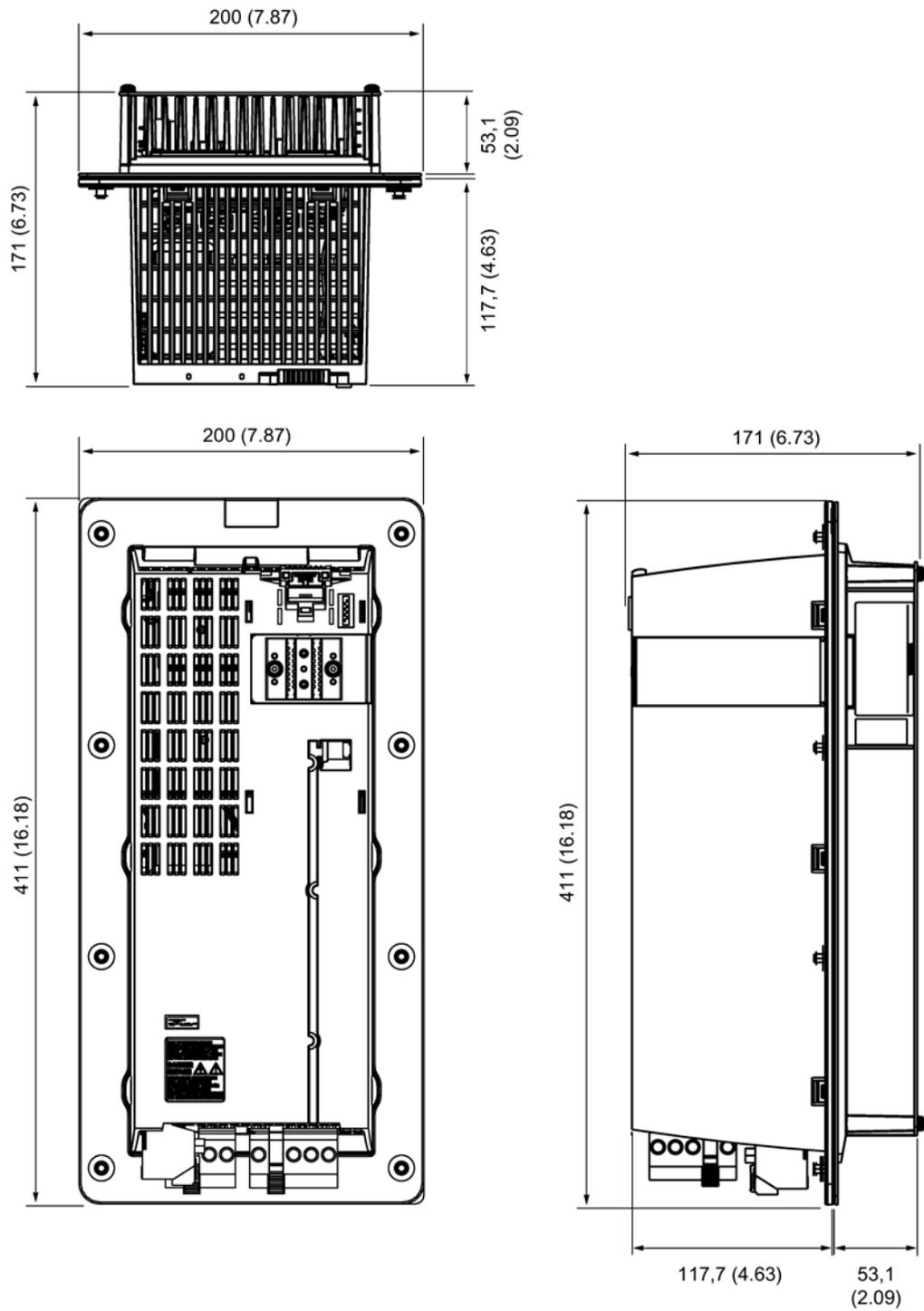


Figure 5-20 Dimension drawing of PM240-2 Push Through Power Modules, frame size FSC, all data in mm (inches)

Cutouts in the control cabinet and mounting holes

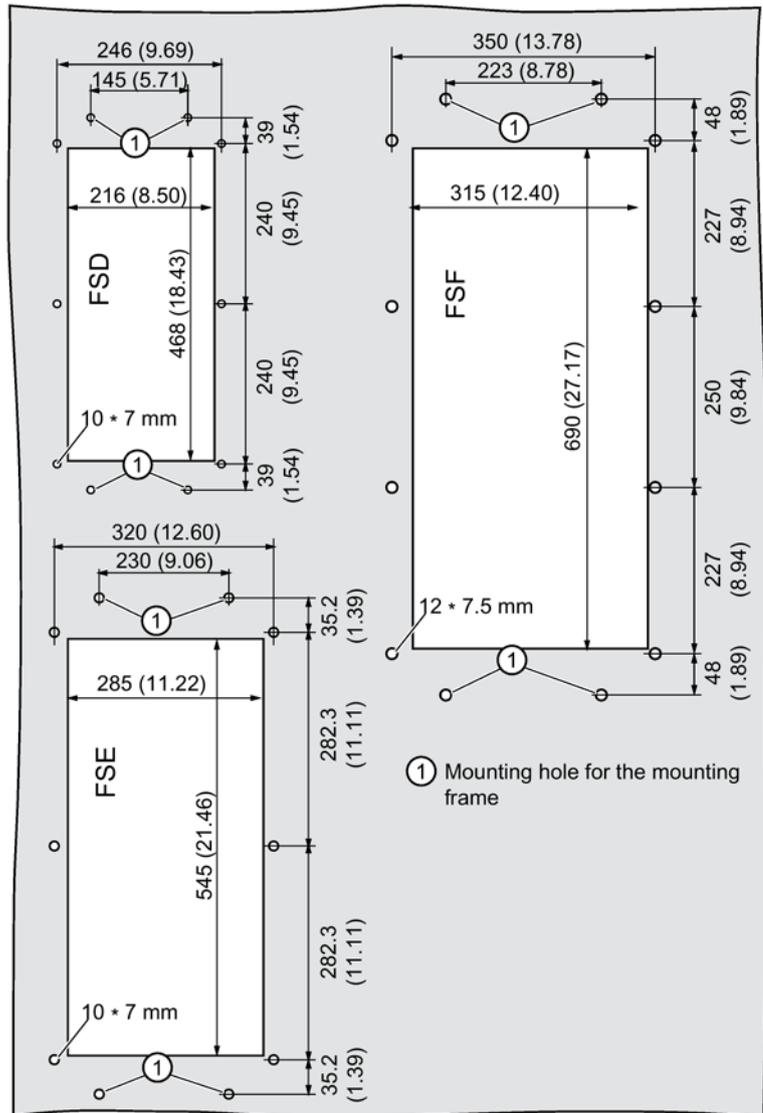
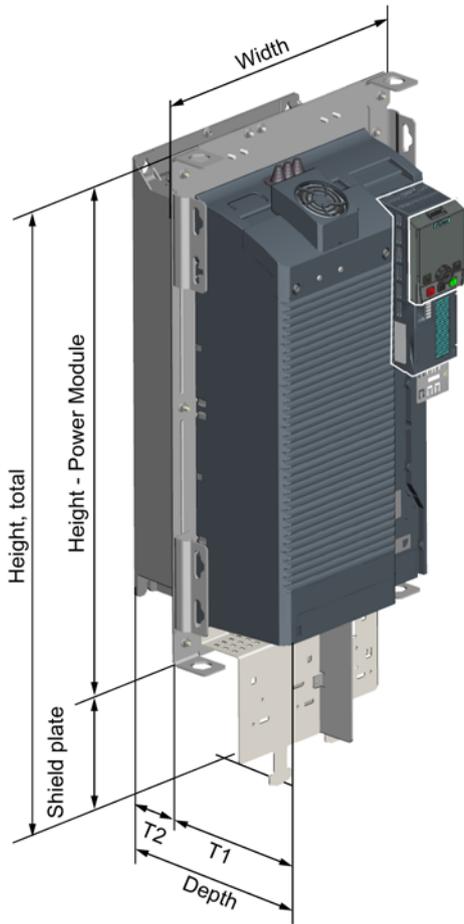


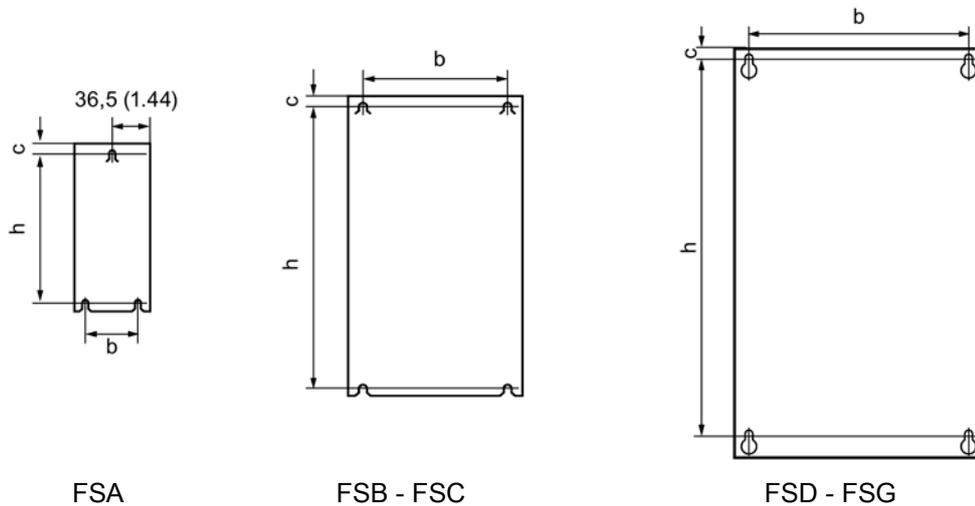
Figure 5-21 Dimension drawing of PM240-2 Push Through Power Modules, frame sizes FSD-FSF, all data in mm

Table 5- 20 Dimensions of PM240-2 PT Power Modules, FSA-FSF

Frame size	Width in mm (inch)	Height in mm (inch)		Mounting depth in mm (inch)		
		without shield plate	with shield plate	In the cabinet T1	Outside T2	Total T1 + T2
FSA	126 (4.96)	238 (9.37)	322 (12.68)	117.7 (4.63)	53.1 (2.09)	170.8 (6.72)
FSB	154 (6.06)	345 (13.58)	430 (16.93)			
FSC	200 (7.8.7)	411 (16.18)	500 (19.69)			
FSD	275 (10.83)	517 (20.35)	650 (25.59)	141 (5.55)	97.5 (3.84)	238.5 (9.39)
FSE	354 (13.94)	615 (24.21)	772 (30.39)			
FSF	384 (15.12)	785 (30.91)	1021 (40.20)	177.5 (6.99)	180.5 (7.11)	358 (14.09)

5.2.5.3 Drilling patterns

Drilling patterns for PM240-2 Power Modules with internal cooling



	Unit	b	h	c
FSA	mm (inch)	62.3 (2.45)	186 (7.32)	6 (0.24)
FSB	mm (inch)	80 (3.15)	281 (11.06)	6 (0.24)
FSC	mm (inch)	120 (4.72)	343 (13.50)	6 (0.24)
FSD	mm (inch)	170 (6.69)	430 (16.93)	7 (0.28)
FSE	mm (inch)	230 (9.06)	509 (20.04)	8.5 (0.33)
FSF	mm (inch)	270 (10.63)	680 (26.77)	13 (0.51)
FSG	mm (inch)	265 (10.43)	970.5 (38.21)	15 (0.59)

Drilling patterns for push through PM240-2 Power Modules

Push through PM240-2 Power Modules with external cooling are mounted in mounting frames in order to maintain the IP54 degree of protection. You can find a description of the mounting frames with dimensions and drilling patterns in Chapter Accessories/mounting frames (Page 359).

5.2.6 Mounting

WARNING

Fire through overheating due to insufficient ventilation clearances

Insufficient ventilation clearances result in overheating with danger to persons as a result of smoke and fire. This can also result in increased downtime and reduced service lives for devices/systems.

- Always install the Power Modules vertical with the line and motor connections below.
- When mounting, maintain a 1 mm clearance between components.
- Ensure the following ventilation clearances above and below the component:
 - For PM240-2 FSA, FSB and FSC Power Modules:
 - Above: 80 mm (3.15 inch)
 - Below: 100 mm (3.93 inch)
 - For PM240-2 FSD, FSE, FSF and FSG Power Modules:
 - Above: 300 mm (11.81 inch)
 - Below: 350 mm (13.78 inch)
 - Front: 100 mm (3.94 inch)
- Only install devices in this area that do not obstruct the flow of cooling air.
- Ensure that the cooling air can flow through the Power Modules unobstructed.

Note

Mounting instructions

- You must mount the PM240-2 Push Through Power Modules on an unpainted metal surface in order to comply with EMC requirements.
- To be able to mount PM240-2 Push Through Power Modules, the wall thickness of the cabinet must be ≤ 3.5 mm.

Note

Installation frame for push through units

An installation frame should be used when push through units are installed in the cabinet. You can find more information about the installation frame in Section Mounting frame (Page 358).

This mounting frame includes the necessary seals and frame to ensure compliance with degree of protection IP54.

If you do not use the mounting frames, you must ensure that the required degree of protection is complied with using other appropriate measures.

5.2.6.1 Mounting dimensions and tightening torques

The mounting dimensions and the tightening torques for fixing the Power Modules are specified in the following table.

Table 5- 21 PM240-2 Power Modules, dimensions and tightening torques for mounting

Frame size		Height, width, depth		Fastening	Tightening torque
		Without shield connection plate	With shield connection plate		
FSA	mm	196 x 73 x 165	276 x 73 x 165	3 x M4 studs, 3 x M4 nuts, 3 x M4 washers	2.5 Nm (22.1 lbf in) with washers
	inch	7.72 x 2.87 x 6.50	10.87 x 2.87 x 6.50		
FSB	mm	292 x 100 x 165	370 x 100 x 165	4 x M4 studs, 4 x M4 nuts, 4 x M4 washers	2.5 Nm (22.1 lbf in) with washers
	inch	11.46 x 3.94 x 6.50	14.57 x 9.94 x 6.50		
FSC	mm	355 x 140 x 165	432 x 140 x 165	4 x M5 studs, 4 x M5 nuts, 4 x M5 washers	3.5 Nm (31.0 lbf in) with washers
	inch	13.98 x 5.51 x 6.50	16.10 x 5.51 x 6.50		
FSD	mm	472 x 200 x 237	707.5 x 200 x 237	4 x M5 studs, 4 x M5 nuts, 4 x M5 washers	6 Nm (53.1 lbf in) with washers
	inch	18.50 x 7.87 x 9.33	27.85 x 7.87 x 9.33		
FSE	mm	551 x 275 x 237	850 x 275 x 237	4 x M6 studs, 4 x M6 nuts, 4 x M6 washers	10 Nm (88.5 lbf in) with washers
	inch	21.69 x 10.83 x 9.33	33.46 x 10.83 x 9.33		
FSF	mm	708 x 305 x 357	1107 x 305 x 357	4 x M8 bolts 4 x M8 nuts 4 x M8 washers	25 Nm (221 lbf in) with washers
	inch	27.87 x 12.01 x 14.06	43.58 x 12.01 x 14.06		
FSG	mm	1000 x 305 x 357	1286 x 305 x 357	4 x M10 bolts 4 x M10 nuts 4 x M10 washers	50 Nm (443 lbf in) with washers
	inch	39.37 x 12.01 x 14.06	50.63 x 12.01 x 14.06		

Table 5- 22 PM240-2 Power Modules Push Through, dimensions and tightening torques for mounting

Frame size		Height, width, depth		Fastening	Tightening torque
		Without shield connection plate	With shield connection plate		
FSA	mm	238 x 126 x 171	322 x 126 x 171	6 x M5 bolts 6 x M5 nuts 6 x M5 washers	3.5 Nm (31.0 lbf in) with washers
	inch	9.37 x 4.96 x 6.73	12.68 x 4.96 x 6.73		
FSB	mm	345 x 154 x 171	430 x 154 x 171	8 x M5 bolts 8 x M5 nuts 8 x M5 washers	3.5 Nm (31.0 lbf in) with washers
	inch	13.58 x 6.06 x 6.73	16.93 x 6.06 x 6.73		
FSC	mm	411 x 200 x 171	500 x 200 x 171	8 x M5 bolts 8 x M5 nuts 8 x M5 washers	3.5 Nm (31.0 lbf in) with washers
	inch	16.18 x 7.87 x 6.73	19.69 x 7.87 x 6.73		
FSD	mm	517 x 275 x 237	650 x 275 x 237	10 x M5 bolts 10 x M5 nuts 10 x M5 washers	3.5 Nm (31.0 lbf in) with washers used
	inch	20.35 x 10.83 x 9.33	25.59 x 10.83 x 9.33		
FSE	mm	615 x 354 x 237	722 x 354 x 237	10 x M5 bolts 10 x M5 nuts 10 x M5 washers	3.5 Nm (31.0 lbf in) with washers used
	inch	24.21 x 13.94 x 9.33	28.43 x 13.94 x 9.33		
FSF	mm	754 x 384 x 358	1021 x 384 x 358	12 x M6 bolts 12 x M6 nuts 12 x M6 washers	5.9 Nm (52.2 lbf in) with washers used
	inch	29.69 x 15.12 x 14.09	40.20 x 15.12 x 14.09		

5.2.6.2 Mounting the shield connection plate

The shield connection plate is used to connect the shields of the two power cables.

Tools required:

- Torx screwdriver T20

Modules, FSA to FSC

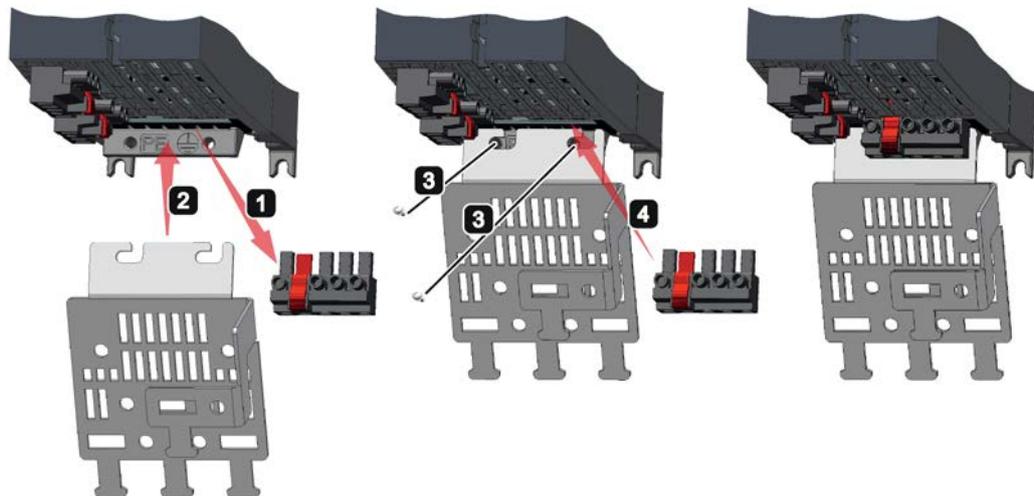


Figure 5-22 Mounting a shield connection plate onto a PM240-2 Power Module, FSA to FSC

Modules FSD and FSE

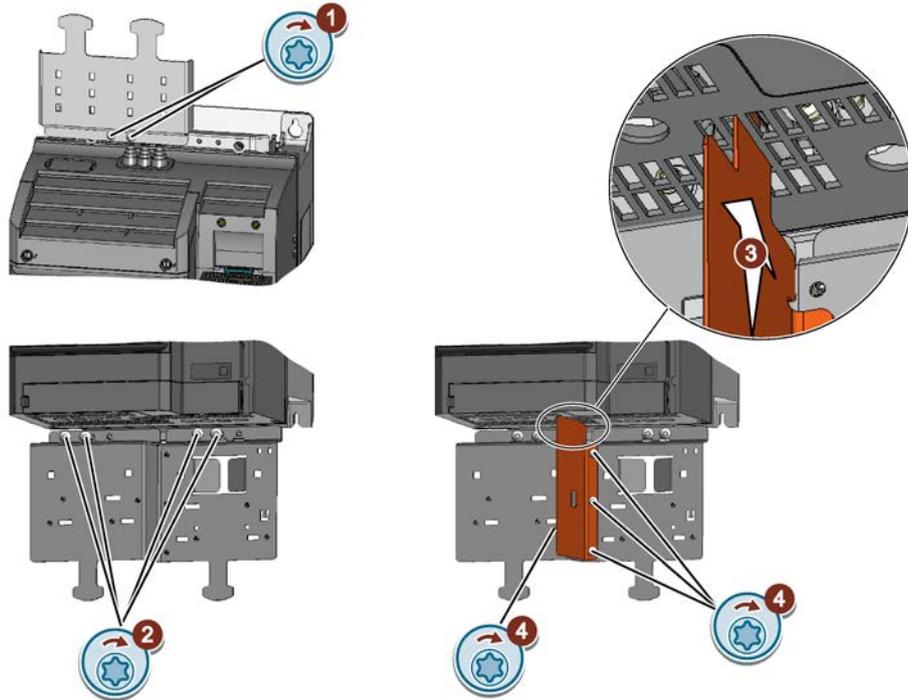


Figure 5-23 Mounting a shield connection plate onto a PM240-2 Power Module, FSD and FSE

Module FSF

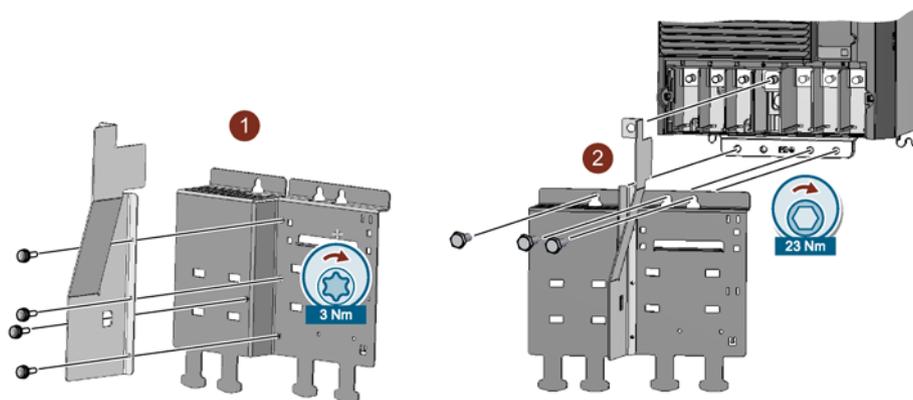


Figure 5-24 Mounting a shield connection plate onto a PM240-2 Power Module, FSF

Module FSG

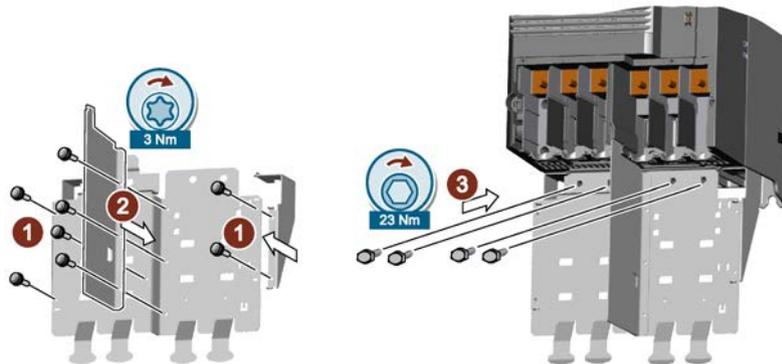


Figure 5-25 Mounting a shield connection plate onto a PM240-2 Power Module, FSG

Push through modules, FSA to FSC

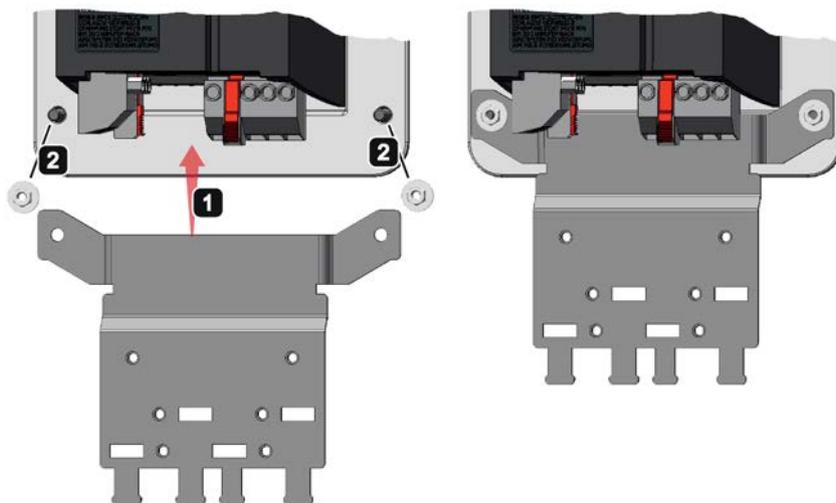


Figure 5-26 Mounting a shield connection plate onto a push through PM240-2 Power Module, FSA to FSC

5.2.7 Electrical connection

5.2.7.1 Special issues when connecting Power Modules FSG

Large connection cross-sections

Note

Cable lugs for M10 bolts according to SN71322 are suitable for cables with cross-sections of 35 mm² ... 185 mm² (1 AWG ... 2 × 350 MCM).

To connect cables with 240 mm² (500 MCM), you must use narrow cable lugs, e.g. Klauke 12SG10. Other cable lugs are not suitable due to the narrow Power Module design. The maximum permissible cable lug width is 37 mm (1.45 inch).

Remove the plastic insulating plate as shown below to gain better access to the terminals for the power connections.

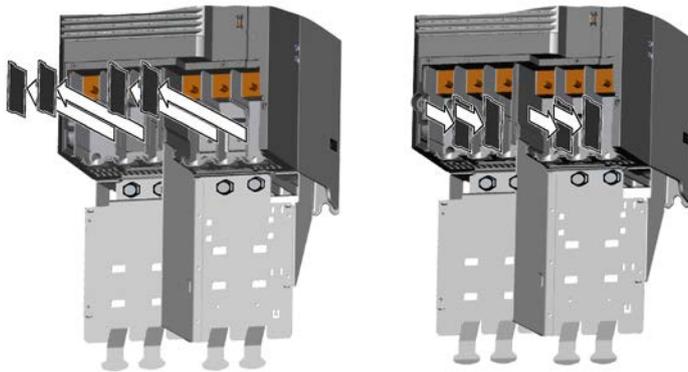


Figure 5-27 PM240-2, FSG, insulating plates

NOTICE
Power Module damage as a result of operation without insulating plates
Without the insulating plates, voltage flashovers may occur between the phases.
<ul style="list-style-type: none">• Replace the insulating plates after connecting the cables.

Remove the grounding screw

PM240-2 Power Modules, frame size FSG can be operated on TN and TT line supplies with grounded neutral point.

Operating PM240-2 modules, frame size FSG with integrated C3 line filter is also possible on TN and TT line supplies without grounded neutral point, as well as on IT line supplies. To do this, you must remove the grounding screw.

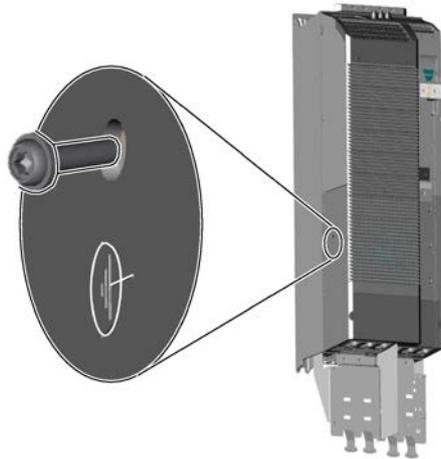


Figure 5-28 Grounding screw at the PM240-2, FSG

Note

If you remove the grounding screw, the EMC properties deteriorate and the requirements of Class C3 are no longer met.

5.2.8 Technical data

Note**Degree of protection of PM240-2 Power Modules**

The Power Modules PM240-2 fulfill degree of protection IP20 per EN 60529.

When push through Power Modules (FSA to FSC) are installed in a cabinet with degree of protection IP54 or IP54 using a suitable mounting frame and seals, the Power Modules also comply with this degree of protection.

According to UL, the push through Power Modules FSD to FSF in the electrical cabinet meet the requirements for an open type component; outside of electrical cabinet, type 1.

5.2.8.1 200 V Power Modules

Table 5- 23 Technical data of the PM240-2, FSA (200 V)

Line voltage 1 AC / 3 AC 200 ... 240 V ±10 %				
		Internal		Push-through
Article No. without integrated line filter with integrated line filter		6SL3210– 1PB13-0UL0 1PB13-0AL0	6SL3210– 1PB13-8UL0 1PB13-8AL0	6SL3211– 1PB13-8UL0 1PB13-8AL0
Output current				
Rated current I_n ¹⁾	A	3.0	3.9	3.9
Base load current I_H	A	2.3	3.0	3.0
for S6 duty (40 %) I_{S6}	A	3.3	4.3	4.3
Peak current I_{max}	A	4.6	6.0	6.0
Type rating ²⁾ based on I_n / based on I_H	kW	0.55 / 0.37	0.75 / 0.55	0.75 / 0.55
Rated pulse frequency	kHz	4	4	4
Max. pulse frequency	kHz	16	16	16
Power loss	kW	0.04	0.04	0.04 ⁵⁾
Cooling air requirement	l/s	5	5	5
Sound pressure level LpA (1 m)	dB	49.2	49.2	49.2
24 V DC supply for the Control Unit	A	1.0	1.0	1.0
Rated input current 1 AC / 3 AC ³⁾	A	7.5 / 4.2	9.6 / 5.5	9.6 / 5.5
Resistance value of the external braking resistor	Ω	≥ 200	≥ 200	≥ 200
Max. cable length to braking resistor	m	15	15	15
Line connection L1, L2, 		Screw-type terminals Cross head M2.5 Conductor cross section: 1.5 ... 2.5 mm ² (AWG 16 ... 14) Tightening torque: 0.5 Nm (4.4 lbf in)		
Motor connection U2, V2, W2, 				
DC-link connection, connection for braking resistor DCP/R1, DCN, R2				
Max. motor cable length ⁴⁾ shielded/unshielded	m	50 / 100		
Degree of protection		IP20		in the cabinet: IP20 outside: IP54
Weight without / with line filter	kg	1.4 / 1.6	1.4 / 1.6	1.8 / 2.0

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 230 V.

3) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to $u_k = 1\%$.

4) To observe the limit values of EN 61800-3 Category C2, for Power Modules PM240-2 with integrated line filter 50 m (shielded) is the max. motor cable length. A cable length up to 150 m is possible for C2 if you use an unfiltered Power Module with an external line filter for Category C2 and a motor reactor.

5) Power loss in the control cabinet: 0.02 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 24 Technical data of the PM240-2, FSB (200 V)

Line voltage 1 AC / 3 AC 200 ... 240 V ± 10 %					
		Internal			Push-through
Article No. without integrated line filter with integrated line filter		6SL3210- 1PB15-5UL0 1PB15-5AL0	6SL3210- 1PB17-4UL0 1PB17-4AL0	6SL3210- 1PB21-0UL0 1PB21-0AL0	6SL3211- 1PB21-0UL0 1PB21-0AL0
Output current					
Rated current I_n ¹⁾	A	5.5	7.4	10.4	10.4
Base load current I_H	A	3.9	5.5	7.4	7.4
for S6 duty (40 %) I_{S6}	A	6.1	8.2	11.5	11.5
Peak current I_{max}	A	8.3	11.1	15.6	15.6
Type rating ²⁾ based on I_n / based on I_H	kW	1.1 / 0.75	1.5 / 1.1	2.2 / 1.5	2.2 / 1.5
Rated pulse frequency	kHz	4	4	4	4
Max. pulse frequency	kHz	16	16	16	16
Power loss	kW	0.05	0.07	0.12	0.12 ⁵⁾
Cooling air requirement	l/s	9.2	9.2	9.2	9.2
Sound pressure level L_pA (1 m)	dB	61.5	61.5	61.5	61.5
24 V DC supply for the Control Unit	A	1.0	1.0	1.0	1.0
Rated input current 1 AC / 3 AC ³⁾	A	13.5 / 7.8	18.1 / 9.7	24.0 / 13.6	24.0 / 13.6
Resistance value of the external braking resistor	Ω	≥ 68	≥ 68	≥ 68	≥ 68
Max. cable length to braking resistor	m	15	15	15	15
Line connection L1, L2, 		Screw-type terminals Cross head M2.5 Conductor cross section: 1.5 ... 6 mm ² (AWG 16 ...10) Tightening torque: 0.6 Nm (5.3 lbf in)			
Motor connection U2, V2, W2, 					
DC-link connection, connection for braking resistor DCP/R1, DCN, R2					
Max. motor cable length ⁴⁾ shielded/unshielded	m	50 / 100			
Degree of protection		IP20			in the cabinet: IP20 outside: IP54
Weight without / with line filter	kg	2.9 / 3.1	2.9 / 3.1	2.9 / 3.1	3.4 / 3.7

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 230 V.

3) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to $u_k = 1$ %.

4) To observe the limit values of EN 61800-3 Category C2, for Power Modules PM240-2 with integrated line filter 50 m (shielded) is the max. motor cable length. A cable length up to 150 m is possible for C2 if you use an unfiltered Power Module with an external line filter for Category C2 and a motor reactor.

5) Power loss in the control cabinet: 0.045 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 25 Technical data of the PM240-2, FSC (200 V) (1/2)

Line voltage 1 AC / 3 AC 200 ... 240 V ±10 %				
		Internal		Push-through
Article No. without integrated line filter with integrated line filter		6SL3210- 1PB21-4UL0 1PB21-4AL0	6SL3210- 1PB21-8UL0 1PB21-8AL0	6SL3211- 1PB21-8UL0 1PB21-8AL0
Output current				
Rated current I_n ¹⁾	A	13.6	17.5	17.5
Base load current I_H	A	10.4	13.6	13.6
for S6 duty (40 %) I_{S6}	A	15.0	19.3	19.3
Peak current I_{max}	A	20.8	27.2	27.2
Type rating ²⁾ based on I_n / based on I_H	kW	3.0 / 2.2	4.0 / 3.0	4.0 / 3.0
Rated pulse frequency	kHz	4	4	4
Max. pulse frequency	kHz	16	16	16
Power loss	kW	0.14	0.18	0.18 ⁵⁾
Cooling air requirement	l/s	18.5	18.5	18.5
Sound pressure level LpA (1 m)	dB	64.9	64.9	64.9
24 V DC supply for the Control Unit	A	1.0	1.0	1.0
Rated input current 1 AC / 3 AC ³⁾	A	35.9 / 17.7	43.0 / 22.8	43.0 / 22.8
Resistance value of the external braking resistor	Ω	≥ 37	≥ 37	≥ 37
Max. cable length to braking resistor	m	15	15	15
Line connection L1, L2, 		Screw-type terminals Cross head M4 Conductor cross section: 6 ... 16 mm ² (AWG 10 ... 6) Tightening torque: 1.3 Nm (11.5 lbf in)		
Motor connection U2, V2, W2, 				
DC-link connection, connection for braking resistor DCP/R1, DCN, R2				
Max. motor cable length ⁴⁾ shielded/unshielded	m	50 / 100		
Degree of protection		IP20		in the cabinet: IP20 outside: IP54
Weight without / with line filter	kg	5.0 / 5.2	5.0 / 5.2	5.9 / 6.2

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 230 V.

3) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to $u_k = 1\%$.

4) To observe the limit values of EN 61800-3 Category C2, for Power Modules PM240-2 with integrated line filter 50 m (shielded) is the max. motor cable length. A cable length up to 150 m is possible for C2 if you use an unfiltered Power Module with an external line filter for Category C2 and a motor reactor.

5) Power loss in the control cabinet: 0.09 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 26 Technical data of the PM240-2, FSC (200 V) (2/2)

Line voltage 3 AC 200 ... 240 V ± 10 %					
		Internal	Push-through	Internal	Push-through
Article No. without integrated line filter with integrated line filter		6SL3210- 1PC22-2UL0 1PC22-2AL0	6SL3211- 1PC22-2UL0 1PC22-2AL0	6SL3210- 1PC22-8UL0 1PC22-8AL0	6SL3211- 1PC22-8UL0 1PC22-8AL0
Output current					
Rated current I_n ¹⁾	A	22.0	22.0	28.0	28.0
Base load current I_H	A	17.5	17.5	22.0	22.0
for S6 duty (40 %) I_{S6}	A	24.2	24.2	30.8	30.8
Peak current I_{max}	A	35.0	35.0	44.0	44.0
Type rating ²⁾ based on I_n / based on I_H	kW	5.5 / 4.0	5.5 / 4.0	7.5 / 5.5	7.5 / 5.5
Rated pulse frequency	kHz	4	4	4	4
Max. pulse frequency	kHz	16	16	16	16
Power loss	kW	0.20	0.20 ⁵⁾	0.26	0.26 ⁶⁾
Cooling air requirement	l/s	18.5	18.5	18.5	18.5
Sound pressure level LpA (1 m)	dB	64.9	64.9	64.9	64.9
24 V DC supply for the Control Unit	A	1.0	1.0	1.0	1.0
Rated input current ³⁾	A	28.6	28.6	36.4	36.4
Resistance value of the external braking resistor	Ω	≥ 20	≥ 20	≥ 20	≥ 20
Max. cable length to braking resistor	m	15	15	15	15
Line connection L1, L2, 		Terminal connector Cable cross-section: 6 ... 16 mm ² (AWG 10 ... 6) Tightening torque: 1.3 Nm (11.5 lbf in)			
Motor connection U2, V2, W2, 					
DC-link connection, connection for braking resistor DCP/R1, DCN, R2					
Max. motor cable length ⁴⁾ shielded/unshielded	m	50 / 100			
Degree of protection		IP20	in the cabinet: IP20 outside: IP54	IP20	in the cabinet: IP20 outside: IP54
Weight without / with line filter	kg	5.0 / 5.2	5.9 / 6.2	5.0 / 5.2	5.9 / 6.2

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 230 V 3 AC

3) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to $u_k = 1$ %.

4) To observe the limit values of EN 61800-3 Category C2, for Power Modules PM240-2 with integrated line filter 50 m (shielded) is the max. motor cable length. A cable length up to 150 m is possible for C2 if you use an unfiltered Power Module with an external line filter for Category C2 and a motor reactor.

5) Power loss in the cabinet is almost 0 kW. The total power loss is dissipated through the heat sink.

6) Power loss in the control cabinet: 0.01 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 27 Technical data of the PM240-2, FSD (200 V)

Line voltage 3 AC 200 ... 240 V ± 10 %					
		Internal			Push-through
Article No. without integrated line filter		6SL3210- 1PC24-2UL0	6SL3210- 1PC25-4UL0	6SL3210- 1PC26-8UL0	6SL3211- 1PC26-8UL0
Output current					
Rated current I_n ¹⁾	A	42	54	68	68
Base load current I_H	A	35	42	54	54
for S6 duty (40 %) I_{S6}	A	50	64	81	81
Peak current I_{max}	A	70	84	108	108
Type rating ²⁾ based on I_n / based on I_H	kW	11 / 7.5	15 / 11	18.5 / 15	18.5 / 15
Rated pulse frequency	kHz	4	4	4	4
Max. pulse frequency	kHz	16	16	16	16
Power loss	kW	0.45	0.61	0.82	0.82 ⁴⁾
Cooling air requirement	l/s	55	55	55	55
Sound pressure level L_{pA} (1 m)³⁾	dB	45 ... 65	45 ... 65	45 ... 65	45 ... 65
24 V DC supply for the Control Unit	A	1.0	1.0	1.0	1.0
Rated input current	A	40	51	64	64
Resistance value of the external braking resistor	Ω	≥ 7.5	≥ 7.5	≥ 7.5	≥ 7.5
Max. cable length to braking resistor	m	15	15	15	15
Line connection L1, L2, 		Screw-type terminal Torx M5 Conductor cross section: 10 ... 35 mm ² (AWG 20 ... 10 / AWG 8 ... 2) Tightening torque: 2.5 ... 4.5 Nm (22 lbf in / 40 lbf in)			
Motor connection U2, V2, W2, 					
DC link connection DCP, DCN					
Connection for braking resistor R1, R2		Screw-type terminal Torx M4 Conductor cross section: 2.5 ... 16 mm ² (AWG 20 ... 6) Tightening torque: 1.2 ... 1.5 Nm (15 lbf in)			
Max. motor cable length no EMC Category: shielded / unshielded	m	200 / 300			
EMC Category C2: shielded	m	150			
Weight	kg	17	17	17	19.5

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 230 V 3 AC

3) The values depend on the ambient temperature and the utilization level.

4) Power loss in the control cabinet: 0.10 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 28 Technical data of the PM240-2, FSE (200 V)

Line voltage 3 AC 200 ... 240 V ±10 %				
		Internal		Push-through
Article No. without integrated line filter		6SL3210- 1PC28-0UL0	6SL3210- 1PC31-1UL0	6SL3211- 1PC31-1UL0
Output current				
Rated current I_n ¹⁾	A	80	104	104
Base load current I_H	A	68	80	80
for S6 duty (40 %) I_{S6}	A	96	124	124
Peak current I_{max}	A	136	160	160
Type rating ²⁾				
based on I_n / based on I_H	kW	22 / 18.5	30 / 22	30 / 22
Rated pulse frequency	kHz	4	4	4
Max. pulse frequency	kHz	16	16	16
Power loss	kW	0.92	1.28	1.28 ⁴⁾
Cooling air requirement	l/s	83	83	83
Sound pressure level L_{pA} (1 m)³⁾	dB	44 ... 62	44 ... 62	44 ... 62
24 V DC supply for the Control Unit	A	1.0	1.0	1.0
Rated input current	A	76	98	98
Resistance value of the external braking resistor	Ω	≥ 4.5	≥ 4.5	≥ 4.5
Max. cable length to braking resistor	m	15	15	15
Line connection L1, L2, 		Screw-type terminal Torx M8 Conductor cross section: 25 ... 70 mm ² (AWG 6 ... 3/0) Tightening torque: 8.0 ... 10 Nm (88.5 lbf in)		
Motor connection U2, V2, W2, 				
DC link connection DCP, DCN				
Connection for braking resistor R1, R2		Screw-type terminal Torx M5 Conductor cross section: 10 ... 35 mm ² (AWG 20 ... 10 / AWG 8 ... 2) Tightening torque: 2.5 ... 4.5 Nm (22 lbf in / 40 lbf in)		
Max. motor cable length no EMC Category: shielded / unshielded	m	200 / 300		
EMC Category C2: shielded	m	150		
Weight	kg	26	26	29

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 230 V 3 AC

3) The values depend on the ambient temperature and the utilization level.

4) Power loss in the control cabinet: 0.18 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 29 Technical data of the PM240-2, FSE (200 V)

Line voltage 3 AC 200 ... 240 V ±10 %					
		Internal			Push-through
Article No. without integrated line filter		6SL3210- 1PC31-3UL0	6SL3210- 1PC31-6UL0	6SL3210- 1PC31-8UL0	6SL3211- 1PC31-8UL0
Output current					
Rated current I_n ¹⁾	A	130	154	178	178
Base load current I_H	A	104	130	154	154
for S6 duty (40 %) I_{S6}	A	156	184	213	213
Peak current I_{max}	A	208	260	308	308
Type rating ²⁾ based on I_n / based on I_H	kW	37 / 30	45 / 37	55 / 45	55 / 45
Rated pulse frequency	kHz	4	4	4	4
Max. pulse frequency	kHz	8	8	8	8
Power loss	kW	1.38	1.72	2.09	2.09 ⁴⁾
Cooling air requirement	l/s	153	153	153	153
Sound pressure level L_{pA} (1 m)³⁾	dB	56 ... 68	56 ... 68	56 ... 68	56 ... 68
24 V DC supply for the Control Unit	A	1.0	1.0	1.0	1.0
Rated input current	A	126	149	172	172
Resistance value of the external braking resistor	Ω	≥ 2.5	≥ 2.5	≥ 2.5	≥ 2.5
Max. cable length to braking resistor	m	15	15	15	15
Line connection L1, L2, 		M10 studs Torx M8 Conductor cross-section: 35 ... 2 x 120 mm ² (AWG 1 ... 2 x 4/0) Tightening torque: 22 ... 25 Nm (210 lbf in)			
Motor connection U2, V2, W2, 					
DC link connection DCP, DCN					
Connection for braking resistor R1, R2		Screw-type terminal Torx M5 Conductor cross section: 25 ... 70 mm ² (AWG 6 ... 3/0) Tightening torque: 8 ... 10 Nm (88.5 lbf in)			
Max. motor cable length no EMC Category: shielded / unshielded EMC Category C2: shielded	m m	300 / 450 150			
Weight	kg	57	57	57	60

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 230 V 3 AC

3) The values depend on the ambient temperature and the utilization level.

4) Power loss in the control cabinet: 0.19 kW. The remaining power loss is dissipated through the heat sink.

5.2.8.2 400 V Power Modules

Table 5- 30 Technical data of the PM240-2, FSA (400 V) (1/2)

Line voltage 3-phase 380 ... 480 V AC \pm 10%					
		Internal			
Article No. without integrated line filter with integrated line filter		6SL3210- 1PE11-8UL1 1PE11-8AL1	6SL3210- 1PE12-3UL1 1PE12-3AL1	6SL3210- 1PE13-2UL1 1PE13-2AL1	6SL3210- 1PE14-3UL1 1PE14-3AL1
Output current					
Rated current I_n ¹⁾	A	1.7	2.2	3.1	4.1
Base load current I_H	A	1.3	1.7	2.2	3.1
for S6 duty (40 %) I_{S6}	A	2.0	2.5	3.5	4.5
Peak current I_{max}	A	2.6	3.4	4.7	6.2
Type rating ²⁾					
based on I_n	kW	0.55	0.75	1.1	1.5
based on I_H	kW	0.37	0.55	0.75	1.1
Rated pulse frequency	kHz	4	4	4	4
Max. pulse frequency	kHz	16	16	16	16
Power loss	kW	0.04	0.04	0.04	0.07
Cooling air requirement	l/s	5	5	5	5
Sound pressure level L_{pA} (1 m)	dB	49.2	49.2	49.2	49.2
24 V DC supply for the Control Unit	A	1.0	1.0	1.0	1.0
Rated input current ³⁾	A	2.3	2.9	4.1	5.5
Resistance value of the external braking resistor	Ω	≥ 370	≥ 370	≥ 370	≥ 370
Max. cable length to braking resistor	m	15	15	15	15
Line connection L1, L2, L3, 		Screw-type terminals			
Motor connection U2, V2, W2, 		Cross head M2.5			
DC-link connection, connection for braking resistor DCP/R1, DCN, R2		Conductor cross section: 1.5 ... 2.5 mm ² (AWG 16 ... 14) Tightening torque: 0.5 Nm (4.4 lbf in)			
Max. motor cable length ⁴⁾ shielded/unshielded	m	50/100			
Degree of protection		IP20			
Weight					
Without line filter	kg	1.4	1.4	1.4	1.4
With line filter	kg	1.5	1.5	1.5	1.5

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 400 V 3 AC

3) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to $u_k = 1\%$.

4) To observe the limit values of EN 61800-3 Category C2, for Power Modules PM240-2 with integrated line filter 50 m (shielded) is the max. motor cable length. A cable length up to 150 m is possible for C2 if you use an unfiltered Power Module with an external line filter for Category C2 and a motor reactor.

Table 5- 31 Technical data of the PM240-2, FSA (400 V) (2/2)

Line voltage 3-phase 380 ... 480 V AC \pm 10%				
		Internal		Push-through
Article No. without integrated line filter with integrated line filter		6SL3210- 1PE16-1UL1 1PE16-1AL1	6SL3210- 1PE18-0UL1 1PE18-0AL1	6SL3211- 1PE18-0UL1 1PE18-0AL1
Output current				
Rated current $I_n^{1)}$	A	5.9	7.7	7.7
Base load current I_H	A	4.1	5.9	5.9
for S6 duty (40 %) I_{S6}	A	6.5	8.5	8.5
Peak current I_{max}	A	8.9	11.8	11.8
Type rating ²⁾ based on I_n / based on I_H	kW	2.2 / 1.5	3.0 / 2.2	3.0 / 2.2
Rated pulse frequency	kHz	4	4	4
Max. pulse frequency	kHz	16	16	16
Power loss	kW	0.1	0.12	0.12 ⁵⁾
Cooling air requirement	l/s	5	5	7
Sound pressure level L_{pA} (1 m)	dB	56.3	56.3	56.3
24 V DC supply for the Control Unit	A	1.0	1.0	1.0
Rated input current ³⁾	A	7.7	10.1	10.1
Resistance value of the external braking resistor	Ω	≥ 140	≥ 140	≥ 140
Max. cable length to braking resistor	m	15	15	15
Line connection L1, L2, L3, 		Screw-type terminals Cross head M2.5 Conductor cross section: 1.5 ... 2.5 mm ² (AWG 16 ... 14) Tightening torque: 0.5 Nm (4.4 lbf in)		
Motor connection U2, V2, W2, 				
DC-link connection, connection for braking resistor DCP/R1, DCN, R2				
Max. motor cable length ⁴⁾ shielded/unshielded	m	50 / 100		
Degree of protection		IP20		in the cabinet: IP20 outside: IP54
Weight without / with line filter	kg	1.4 / 1.5	1.4 / 1.5	1.7 / 1.8

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 400 V 3 AC

3) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to $u_k = 1\%$.

4) To observe the limit values of EN 61800-3 Category C2, for Power Modules PM240-2 with integrated line filter 50 m (shielded) is the max. motor cable length. A cable length up to 150 m is possible for C2 if you use an unfiltered Power Module with an external line filter for Category C2 and a motor reactor.

5) Power loss in the control cabinet: 0.02 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 32 Technical data of the PM240-2, FSB (400 V)

Line voltage 3 AC 380 ... 480 V ±10 %					
		Internal			Push-through
Article No. without integrated line filter with integrated line filter		6SL3210– 1PE21-1UL0 1PE21-1AL0	6SL3210– 1PE21-4UL0 1PE21-4AL0	6SL3210– 1PE21-8UL0 1PE21-8AL0	6SL3211– 1PE21-8UL0 1PE21-8AL0
Output current					
Rated current I_n ¹⁾	A	10.2	13.2	18.0	18.0
Base load current I_H	A	7.7	10.2	13.2	13.2
for S6 duty (40 %) I_{S6}	A	11.2	14.5	19.8	19.8
Peak current I_{max}	A	15.4	20.4	27.0	27.0
Type rating ²⁾ based on I_n / based on I_H	kW	4.0 / 3.0	5.5 / 4.0	7.5 / 5.5	7.5 / 5.5
Rated pulse frequency	kHz	4	4	4	4
Max. pulse frequency	kHz	16	16	16	16
Power loss	kW	0.11	0.15	0.2	0.2 ⁵⁾
Cooling air requirement	l/s	9.2	9.2	9.2	9.2
Sound pressure level L_{pA} (1 m)	dB	61.5	61.5	61.5	61.5
24 V DC supply for the Control Unit	A	1.0	1.0	1.0	1.0
Rated input current ³⁾	A	13.3	17.2	22.2	22.2
Resistance value of the external braking resistor	Ω	≥ 75	≥ 75	≥ 75	≥ 75
Max. cable length to braking resistor	m	15	15	15	15
Line connection L1, L2, L3, 		Screw-type terminals Cross head M2.5 Conductor cross section: 1.5 ... 6 mm ² (AWG 16 ...10) Tightening torque: 0.6 Nm (5.3 lbf in)			
Motor connection U2, V2, W2, 					
DC-link connection, connection for braking resistor DCP/R1, DCN, R2					
Max. motor cable length ⁴⁾ shielded/unshielded	m	50 / 100			
Degree of protection		IP20			in the cabinet: IP20 outside: IP54
Weight without / with line filter	kg	2.9 / 3.1	2.9 / 3.1	3.0 / 3.2	3.6 / 3.9

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 400 V 3 AC

3) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to $u_k = 1\%$.

4) To observe the limit values of EN 61800-3 Category C2, for Power Modules PM240-2 with integrated line filter 50 m (shielded) is the max. motor cable length. A cable length up to 150 m is possible for C2 if you use an unfiltered Power Module with an external line filter for Category C2 and a motor reactor.

5) Power loss in the control cabinet: 0.045 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 33 Technical data of the PM240-2, FSC (400 V)

Line voltage 3 AC 380 ... 480 V ±10 %				
		Internal		Push-through
Article No. without integrated line filter with internal line filter		6SL3210- 1PE22-7UL0 1PE22-7AL0	6SL3210- 1PE23-3UL0 1PE23-3AL0	6SL3211- 1PE23-3UL0 1PE23-3AL0
Output current				
Rated current $I_n^{1)}$	A	26.0	32.0	32.0
Base load current I_H	A	18.0	26.0	26.0
for S6 duty (40 %) I_{S6}	A	28.6	37.1	37.1
Peak current I_{max}	A	39.0	52.0	52.0
Type rating²⁾ based on I_n / based on I_H	kW	11.0 / 7.5	15.0 / 11.0	15.0 / 11.0
Rated pulse frequency	kHz	4	4	4
Max. pulse frequency	kHz	16	16	16
Power loss	kW	0.3	0.37	0.37 ⁵⁾
Cooling air requirement	l/s	18.5	18.5	18.5
Sound pressure level LpA (1 m)	dB	64.9	64.9	64.9
24 V DC supply for the Control Unit	A	1.0	1.0	1.0
Rated input current³⁾	A	32.6	39.9	39.9
Resistance value of the external braking resistor	Ω	≥ 30	≥ 30	≥ 30
Max. cable length to braking resistor	m	15	15	15
Line connection L1, L2, L3, 		Screw-type terminals Cross head M4 Conductor cross section: 6 ... 16 mm ² (AWG 10 ... 6) Tightening torque: 1.3 Nm (11.5 lbf in)		
Motor connection U2, V2, W2, 				
DC-link connection, connection for braking resistor DCP/R1, DCN, R2				
Max. motor cable length⁴⁾ shielded/unshielded	m	50 / 100		
Degree of protection		IP20		in the cabinet: IP20 outside: IP54
Weight without / with line filter	kg	4.7 / 5.3	4.8 / 5.4	5.8 / 6.3

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 400 V 3 AC

3) The input current depends on the motor load and line impedance. The input currents apply for a load with the type rating (based on I_{rated}) for a line impedance corresponding to $u_k = 1\%$.

4) To observe the limit values of EN 61800-3 Category C2, for Power Modules PM240-2 with integrated line filter 50 m (shielded) is the max. motor cable length. A cable length up to 150 m is possible for C2 if you use an unfiltered Power Module with an external line filter for Category C2 and a motor reactor.

5) Power loss in the control cabinet: 0.075 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 34 Technical data of the PM240-2, FSD (400 V)

Line voltage 3 AC 380 ... 480 V ±10 %						
		Internal				Push-through
Article No. without integrated line filter with internal line filter		6SL3210- 1PE23-8UL0 1PE23-8AL0	6SL3210- 1PE24-5UL0 1PE24-5AL0	6SL3210- 1PE26-0UL0 1PE26-0AL0	6SL3210- 1PE27-5UL0 1PE27-5AL0	6SL3211- 1PE27-5UL0 1PE27-5AL0
Output current						
Rated current $I_n^{1)}$	A	38	45	60	75	75
Base load current I_H	A	32	38	45	60	60
for S6 duty (40 %) I_{S6}	A	45	54	72	90	90
Peak current I_{max}	A	64	76	90	120	120
Type rating²⁾						
based on I_n / based on I_H	kW	18.5 / 15	22 / 18.5	30 / 22	37 / 30	37 / 30
Rated pulse frequency	kHz	4	4	4	4	4
Max. pulse frequency	kHz	16	16	16	16	16
Power loss						
without filter with filter	kW	0.57 / 0.58	0.70 / 0.71	0.82 / 0.83	1.09 / 1.10	1.09 / 1.10 ⁵⁾
Cooling air requirement	l/s	55	55	55	55	55
Sound pressure level L_{pA} (1 m)³⁾	dB	45 ... 65	45 ... 65	45 ... 65	45 ... 65	45 ... 65
24 V DC supply for the Control Unit	A	1.0	1.0	1.0	1.0	1.0
Rated input current	A	36	42	57	70	70
Resistance value of the external braking resistor	Ω	≥ 25	≥ 25	≥ 15	≥ 15	≥ 15
Max. cable length to braking resistor	m	15	15	15	15	15
Line connection L1, L2, L3, 		Screw terminal; Torx M5				
Motor connection U2, V2, W2, 		Cable cross-section: 10 ... 35 mm ² (AWG 20 ... 10 / AWG 8 ... 2)				
DC link connection DCP, DCN		Tightening torque: 2.5 ... 4.5 Nm (22 lbf in / 40 lbf in)				
Connection for braking resistor R1, R2		Screw terminal; Torx M4				
		Cable cross-section: 2.5 ... 16 mm ² (AWG 20 ... 6)				
		Tightening torque: 1.2 ... 1.5 Nm (15 lbf in)				
Max. motor cable length⁴⁾						
no EMC Category	m	200 / 300				
shielded / unshielded	m	150				
with filter and shielded: EMC Category C2						
Degree of protection		IP20				In the control cabinet: IP20 outside: IP54
Weight						
without / with line filter	kg	16 / 17.5	16 / 17.5	17 / 18.5	17 / 18.5	20 / 21.5

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 400 V 3 AC

3) The values depend on the ambient temperature and the utilization level.

4) Please observe the additional restrictions for the 6SL321.-1PE27-5UL0 Power Module

- Motor cable length 50 to 100 m: Set the pulse frequency to 2 kHz.
- Motor cable length > 100 m: Reduce the base load current for each 10 m by 1 %.

5) Power loss in the control cabinet: 0.10 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 35 Technical data of the PM240-2, FSE (400 V)

Line voltage 3 AC 380 ... 480 V ± 10 %				
		Internal		Push-through
Article No. without integrated line filter with internal line filter		6SL3210- 1PE28-8UL0 1PE28-8AL0	6SL3210- 1PE31-1UL0 1PE31-1AL0	6SL3211- 1PE31-1UL0 1PE31-1AL0
Output current				
Rated current $I_n^{1)}$	A	90	110	110
Base load current I_H	A	75	90	90
for S6 duty (40 %) I_{S6}	A	108	132	132
Peak current I_{max}	A	150	180	180
Type rating ²⁾ based on I_n / based on I_H	kW	45 / 37	55 / 45	55 / 45
Rated pulse frequency	kHz	4	4	4
Max. pulse frequency	kHz	16	8	8
Power loss without filter / with filter	kW	1.29 / 1.30	1.65 / 1.67	1.65 / 1.67 ⁵⁾
Cooling air requirement	l/s	83	83	83
Sound pressure level L_{pA} (1 m) ³⁾	dB	44 ... 62	44 ... 62	44 ... 62
24 V DC supply for the Control Unit	A	1.0	1.0	1.0
Rated input current	A	86	104	104
Resistance value of the external braking resistor	Ω	≥ 10	≥ 10	≥ 10
Max. cable length to braking resistor	m	15	15	15
Line connection L1, L2, L3, 		Screw terminal; Torx M8		
Motor connection U2, V2, W2, 		Cable cross-section: 25 ... 70 mm ² (AWG 6 ... 3/0)		
DC link connection DCP, DCN		Tightening torque: 8.0 ... 10 Nm (88.5 lbf in)		
Connection for braking resistor R1, R2		Screw terminal; Torx M5		
		Cable cross-section: 10 ... 35 mm ² (AWG 20 ... 10 / AWG 8 ... 2)		
		Tightening torque: 2.5 ... 4.5 Nm (22 lbf in / 40 lbf in)		
Max. motor cable length ⁴⁾ no EMC Category shielded / unshielded	m	200 / 300		
with filter and shielded: EMC Category C2	m	150		
Degree of protection		IP20		in the cabinet: IP20 outside: IP54
Weight without / with line filter	kg	26 / 28	26 / 28	30.5 / 32

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 400 V 3 AC

3) The values depend on the ambient temperature and the utilization level.

4) Please observe the additional restrictions for the 6SL321.-1PE31-1UL0 Power Module

- Motor cable length 50 to 100 m: Set the pulse frequency to 2 kHz.
- Motor cable length > 100 m: Reduce the base load current for each 10 m by 1 %.

5) Power loss in the control cabinet: 0.26 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 36 Technical data of the PM240-2, FSE (400 V)

Line voltage 3 AC 380 ... 480 V ±10 %						
		Internal				Push-through
Article No. without integrated line filter with internal line filter		6SL3210- 1PE31-5UL0 1PE31-5AL0	6SL3210- 1PE31-8UL0 1PE31-8AL0	6SL3210- 1PE32-1UL0 1PE32-1AL0	6SL3210- 1PE32-5UL0 1PE32-5AL0	6SL3211- 1PE32-5UL0 1PE32-5AL0
Output current						
Rated current $I_n^{1)}$	A	145	178	205	250	250
Base load current I_H	A	110	145	178	205	205
for S6 duty (40 %) I_{S6}	A	174	213	246	300	300
Peak current I_{max}	A	220	290	356	410	410
Type rating²⁾						
based on I_n / based on I_H	kW	75 / 55	90 / 75	110 / 90	132 / 110	132 / 110
Rated pulse frequency	kHz	2/4 ³⁾	2/4 ³⁾	2	2	2
Max. pulse frequency	kHz	8	8	4	4	4
Power loss						
without filter / with filter	kW	1.91 / 1.93	2.46 / 2.48	2.28 / 2.30	2.98 / 3.02	2.98 / 3.02 ⁵⁾
Cooling air requirement	l/s	200	200	200	200	200
Sound pressure level L_{pA} (1 m)⁴⁾	dB	56 ... 68	56 ... 68	56 ... 68	56 ... 68	56 ... 68
24 V DC supply for the Control Unit	A	1.0	1.0	1.0	1.0	1.0
Rated input current	A	140	172	198	242	242
Resistance value of the external braking resistor	Ω	≥ 7.1	≥ 7.1	≥ 5	≥ 5	≥ 5
Max. cable length to braking resistor	m	15	15	15	15	15
Line connection L1, L2, L3, 		Cable lug for M10 bolts				
Motor connection U2, V2, W2, 		Cable cross-section: 35 ... 2 x 120 mm ² (AWG 1 ... 2 x 4/0)				
DC link connection DCP, DCN		Tightening torque: 22 ... 25 Nm (210 lbf in)				
Connection for braking resistor R1, R2		Screw terminal; Torx M5 Cable cross-section: 25 ... 70 mm ² (AWG 6 ... 3/0) Tightening torque: 8 ... 10 Nm (88.5 lbf in)				
Max. motor cable length no EMC Category: shielded / unshielded with filter and shielded: EMC Category C2	m m	300 / 450 150				
Degree of protection		IP20				In the control cabinet: IP20 outside: IP54
Weight without / with line filter	kg	57 / 63	57 / 63	61 / 65	61 / 65	63.5 / 68

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 400 V 3 AC

3) To maintain limit values of EN 61800-3 Category C2 only 2 kHz (however, no current derating between 2 kHz and 4 kHz)

4) The values depend on the ambient temperature and the utilization level.

5) Power loss in the control cabinet: 0.4 kW. The remaining power loss is dissipated through the heat sink.

Table 5- 37 Technical data of the PM240-2, FSG (400 V)

Line voltage 3 AC 380 ... 480 V $\pm 10\%$				
		Internal		
Article number with internal C3 line filter with internal C2 line filter		6SL3210- 1PE33-0CLO 1PE33-0ALO	6SL3210- 1PE33-7CLO 1PE33-7ALO	6SL3210- 1PE34-8CLO 1PE34-8ALO
Output current				
Rated current $I_n^{1)}$	A	302	370	477
Base load current I_H	A	250	302	370
for S6 duty (40 %) I_{S6}	A	362	444	572
Peak current I_{max}	A	500	604	740
Type rating²⁾ based on I_n / based on I_H	kW	160 / 132	200 / 160	250 / 200
Rated pulse frequency	kHz	2	2	2
Max. pulse frequency	kHz	8	8	8
Power loss with filter	kW	3.67	4.62	6.18
Cooling air requirement	l/s	210	210	210
Sound pressure level L_{pA} (1 m)³⁾	dB	≤ 75	≤ 75	≤ 75
24 V DC supply for the Control Unit	A	1.0	1.0	1.0
Rated input current	A	300	365	470
Resistance value of the external braking resistor	Ω	≥ 2.2	≥ 2.2	≥ 2.2
Max. cable length to braking resistor	m	15	15	15
Line connection L1, L2, L3, 		Cable lug for M10 bolts		
Motor connection U2, V2, W2, 		Cable cross-section: 35 ... 2 x 185 mm ² (AWG 1 ... 2 x 350 MCM)		
DC link connection DCP, DCN		Tightening torque: 22 ... 25 Nm (210 lbf in)		
Connection for braking resistor R1, R2		Screw terminal; Torx M5 Cable cross-section: 25 ... 70 mm ² (AWG 6 ... 3/0) Tightening torque: 8 ... 10 Nm (88.5 lbf in)		
Max. motor cable length no EMC Category: shielded / unshielded	m	300 / 450		
with filter and shielded: EMC Category C2/C3	m	150 / 300		
Weight with Class C3 line filter	kg	105	113	120
with Class C2 line filter	kg	107	114	122

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 400 V 3 AC

3) The values depend on the ambient temperature and the utilization level.

5.2.8.3 690 V Power Modules

Table 5- 38 Technical data of the PM240-2, FSD (690 V) (1/2)

Line voltage 3 AC 500 ... 690 V ± 10 %				
Article No. without integrated line filter with integrated line filter		6SL3210- 1PH21-4UL0 1PH21-4AL0	6SL3210- 1PH22-0UL0 1PH22-0AL0	6SL3210- 1PH22-3UL0 1PH22-3AL0
Output current				
Rated current I_n ¹⁾	A	14	19	23
Base load current I_H	A	11	14	19
for S6 duty (40%) I_{S6}	A	16	22	27
Peak current I_{max}	A	22	29	38
Type rating ²⁾				
based on I_n / based on I_H	kW	11 / 7.5	15 / 11	18.5 / 15
Rated pulse frequency	kHz	2	2	2
Max. pulse frequency	kHz	4	4	4
Power loss				
without filter with filter	kW	0.35 / 0.35	0.44 / 0.45	0.52 / 0.52
Cooling air requirement	l/s	55	55	55
Sound pressure level L_{pA} (1 m) ³⁾	dB	45 ... 65	45 ... 65	45 ... 65
24 V DC supply for the Control Unit	A	1.0	1.0	1.0
Rated input current	A	14	18	22
Resistance value of the external braking resistor	Ω	31	31	31
Max. cable length to braking resistor	m	15	15	15
Line connection L1, L2, L3, \oplus		Screw terminal; Torx M5		
Motor connection U2, V2, W2, \oplus		Cable cross-section: 10 ... 35 mm ² (AWG 20 ... 10 / AWG 8 ... 2)		
DC link connection DCP, DCN		Tightening torque: 2.5 ... 4.5 Nm (22 lbf in / 40 lbf in)		
Connection for braking resistor R1, R2, \oplus		Screw terminal; Torx M4 Cable cross-section: 2.5 ... 16 mm ² (AWG 20 ... 6) Tightening torque: 1.2 ... 1.5 Nm (15 lbf in)		
Max. motor cable length no EMC Category: shielded / unshielded with filter and shielded: EMC Category C2	m m	200 / 300 100		
Weight without / with line filter	kg	17 / 18.5	17 / 18.5	17 / 18.5

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 3 AC 690 V

3) The values depend on the ambient temperature and the utilization level.

Table 5- 39 Technical data of the PM240-2, FSD (690 V) (2/2)

Line voltage 3 AC 500 ... 690 V ±10 %				
		Internal		
Article No. without integrated line filter with integrated line filter		6SL3210- 1PH22-7UL0 1PH22-7AL0	6SL3210- 1PH23-5UL0 1PH23-5AL0	6SL3210- 1PH24-2UL0 1PH24-2AL0
Output current				
Rated current $I_n^{1)}$	A	27	35	42
Base load current I_H	A	23	27	35
for S6 duty (40 %) I_{S6}	A	32	42	50
Peak current I_{max}	A	46	54	70
Type rating²⁾ based on I_n / based on I_H	kW	22 / 18.5	30 / 22	37 / 30
Rated pulse frequency	kHz	2	2	2
Max. pulse frequency	kHz	4	4	4
Power loss without filter / with filter	kW	0.60 / 0.60	0.77 / 0.78	0.93 / 0.94
Cooling air requirement	l/s	55	55	55
Sound pressure level L_pA (1 m)³⁾	dB	45 ... 65	45 ... 65	45 ... 65
24 V DC supply for the Control Unit	A	1.0	1.0	1.0
Rated input current	A	25	33	40
Resistance value of the external braking resistor	Ω	31	31	31
Max. cable length to braking resistor	m	15	15	15
Line connection L1, L2, L3, ⚡		Screw terminal; Torx M5		
Motor connection U2, V2, W2, ⚡		Cable cross-section: 10 ... 35 mm ² (AWG 20 ... 10 / AWG 8 ... 2)		
DC link connection DCP, DCN		Tightening torque: 2.5 ... 4.5 Nm (22 lbf in / 40 lbf in)		
Connection for braking resistor R1, R2, ⚡		Screw terminal; Torx M4 Cable cross-section: 2.5 ... 16 mm ² (AWG 20 ... 6) Tightening torque: 1.2 ... 1.5 Nm (15 lbf in)		
Max. motor cable length no EMC Category: shielded / unshielded	m	200 / 300		
with filter and shielded: EMC Category C2/C3	m	100		
Weight without / with line filter	kg	17 / 18.5	17 / 18.5	17 / 18.5

- 1) Rated current I_n covers the load cycle for Low Overload.
- 2) Rated power of a typical standard induction motor at 3 AC 690 V
- 3) The values depend on the ambient temperature and the utilization level.

Table 5- 40 Technical data of the PM240-2, FSE (690 V)

Line voltage 3 AC 500 ... 690 V ±10 %			
		Internal	
Article No. without integrated line filter with integrated line filter		6SL3210- 1PH25-2UL0 1PH25-2AL0	6SL3210- 1PH26-2UL0 1PH26-2AL0
Output current Rated current $I_n^{1)}$ Base load current I_H for S6 duty (40 %) I_{S6} Peak current I_{max}	A A A A	52 42 62 84	62 52 74 104
Type rating²⁾ based on I_n / based on I_H	kW	45 / 37	55 / 45
Rated pulse frequency Max. pulse frequency	kHz kHz	2 4	2 4
Power loss without filter / with filter	kW	1.07 / 1.08	1.30 / 1.31
Cooling air requirement	l/s	83	83
Sound pressure level L_{pA} (1 m)³⁾	dB	44 ... 62	44 ... 62
24 V DC supply for the Control Unit	A	1.0	1.0
Rated input current	A	50	59
Resistance value of the external braking resistor	Ω	21	21
Max. cable length to braking resistor	m	15	15
Line connection L1, L2, L3, 		Screw-type terminal Torx M8 Conductor cross section. 25 ... 70 mm ² (AWG 6 ... 3/0) Tightening torque: 8.0 ... 10 Nm (88.5 lbf in)	
Motor connection U2, V2, W2, 			
DC link connection DCP, DCN			
Connection for braking resistor R1, R2, 		Screw-type terminal Torx M5 Conductor cross section: 10 ... 35 mm ² (AWG 20 ... 10 / AWG 8 ... 2) Tightening torque: 2.5 ... 4.5 Nm (22 lbf in / 40 lbf in)	
Max. motor cable length no EMC Category: shielded / unshielded with filter and shielded: EMC Category C2	m m	200 / 300 100	
Weight without / with line filter	kg	26 / 28	26 / 28

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 3 AC 690 V

3) The values depend on the ambient temperature and the utilization level.

Table 5- 41 Technical data of the PM240-2, FSF (690 V)

Line voltage 3 AC 500 ... 690 V $\pm 10\%$					
		Internal			
Article No. without integrated line filter with integrated line filter (for C3)		6SL3210- 1PH28-0UL0 1PH28-0AL0	6SL3210- 1PH31-0UL0 1PH31-0AL0	6SL3210- 1PH31-2UL0 1PH31-2AL0	6SL3210- 1PH31-4UL0 1PH31-4AL0
Output current					
Rated current I_n ¹⁾	A	80	100	115	142
Base load current I_H	A	62	80	100	115
for S6 duty (40 %) I_{S6}	A	96	120	138	170
Peak current I_{max}	A	124	160	200	230
Type rating ²⁾ based on I_n / based on I_H	kW	75 / 55	90 / 75	110 / 90	132 / 110
Rated pulse frequency	kHz	2	2	2	2
Max. pulse frequency	kHz	4	4	4	4
Power loss without filter / with filter	kW	1.37 / 1.38	1.74 / 1.76	1.95 / 1.97	2.48 / 2.51
Cooling air requirement	l/s	83	83	200	200
Sound pressure level LpA (1 m) ³⁾	dB	56 ... 58	56 ... 68	56 ... 68	56 ... 68
24 V DC supply for the Control Unit	A	1.0	1.0	1.0	1.0
Rated input current	A	78	97	111	137
Resistance value of the external braking resistor	Ω	10.5	10.5	10.5	10.5
Max. cable length to braking resistor	m	15	15	15	15
Line connection L1, L2, L3, 		Cable lug for M10 bolts Cable cross-section: 35 ... 2 x 120 mm ² (AWG 1 ... 2 x 4/0) Tightening torque: 22 ... 25 Nm (210 lbf in)			
Motor connection U2, V2, W2, 					
DC link connection DCP, DCN					
Connection for braking resistor R1, R2, 		Screw terminal; Torx M5 Cable cross-section: 25 ... 70 mm ² (AWG 6 ... 3/0) Tightening torque: 8 ... 10 Nm (88.5 lbf in)			
Max. motor cable length no EMC Category: shielded / unshielded with filter and shielded: EMC Category C3	m m	300 / 450 150			
Weight without / with line filter	kg	60 / 64	60 / 64	60 / 64	60 / 64

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 3 AC 690 V

3) The values depend on the ambient temperature and the utilization level.

Table 5- 42 Technical data of the PM240-2, FSG (690 V)

Line voltage 3 AC 500 ... 690 V ± 10 %				
		Internal		
Article number with internal C3 line filter		6SL3210- 1PH31-7CL0	6SL3210- 1PH32-1CL0	6SL3210- 1PH32-5CL0
Output current				
Rated current $I_n^{1)}$	A	171	208	250
Base load current I_H	A	144	171	208
for S6 duty (40 %) I_{S6}	A	205	250	300
Peak current I_{max}	A	288	342	416
Type rating²⁾ based on I_n / based on I_H	kW	160 / 132	200 / 160	250 / 200
Rated pulse frequency	kHz	2	2	2
Max. pulse frequency	kHz	4	4	4
Power loss with filter	kW	3.0	3.5	4.1
Cooling air requirement	l/s	210	210	210
Sound pressure level L_{pA} (1 m)³⁾	dB	≤ 75	≤ 75	≤ 75
24 V DC supply for the Control Unit	A	1.0	1.0	1.0
Rated input current	A	170	205	250
Resistance value of the external braking resistor	Ω	≥ 4.9	≥ 4.9	≥ 4.9
Max. cable length to braking resistor	m	15	15	15
Line connection L1, L2, L3, 		Cable lug for M10 bolts Cable cross-section: 35 ... 2 x 185 mm ² (AWG 1 ... 2 x 350 MCM) Tightening torque: 22 ... 25 Nm (210 lbf in)		
Motor connection U2, V2, W2, 				
DC link connection DCP, DCN				
Connection for braking resistor R1, R2		Screw terminal; Torx M5 Cable cross-section: 25 ... 70 mm ² (AWG 6 ... 3/0) Tightening torque: 8 ... 10 Nm (88.5 lbf in)		
Max. motor cable length no EMC Category: shielded / unshielded with filter and shielded: EMC category C3	m	300 / 450		
	m	300		
Weight with Class C3 line filter	kg	114	114	114

1) Rated current I_n covers the load cycle for Low Overload.

2) Rated power of a typical standard induction motor at 3 AC 690 V

3) The values depend on the ambient temperature and the utilization level.

5.2.8.4 Harmonic currents

Note

Limit values for temperature monitoring

Carefully comply with the device-specific information and instructions for maintaining harmonic current limits.

With respect to maintaining limit values for harmonic currents, the EMC product standard EN61800-3 for drive systems (PDS) refers to compliance with standards EN 61000-3-2 and EN 61000-3-12.

Typical harmonic currents

Table 5- 43 Typical harmonic currents (%) of the converter

Converter	Harmonic number							
	5th	7th	11th	13th	17th	19th	23rd	25th
FSA ... FSC, 200 V, 400 V ¹⁾	54	39	11	5.5	5	3	2	2
FSD ... FSF, 200 V ²⁾	28	14	8	6	5	4	3	3
FSD ... FSG, 400 V ²⁾	37	21	7	5	4	3	3	2
FSD ... FSG, 690 V ²⁾	34	18	8	5	4	3	3	2

1) Values referred to the rated input current input current for U_k 1 %

2) Values referred to the rated input current

5.2.9 Characteristics

5.2.9.1 Current derating

Derating as a function of the ambient temperature and installation altitude

You can find data regarding derating as a function of the ambient temperature and installation altitude in Chapter System data (Page 38).

Derating as a function of the pulse frequency

If the Power Modules are operated at a pulse frequency that is above the rated pulse frequency, then you must reduce the output currents I_n, I_H, I_{S6} and I_{max} as follows:

Note

You will find the rated pulse frequency in the Technical Data of the relevant Power Module.

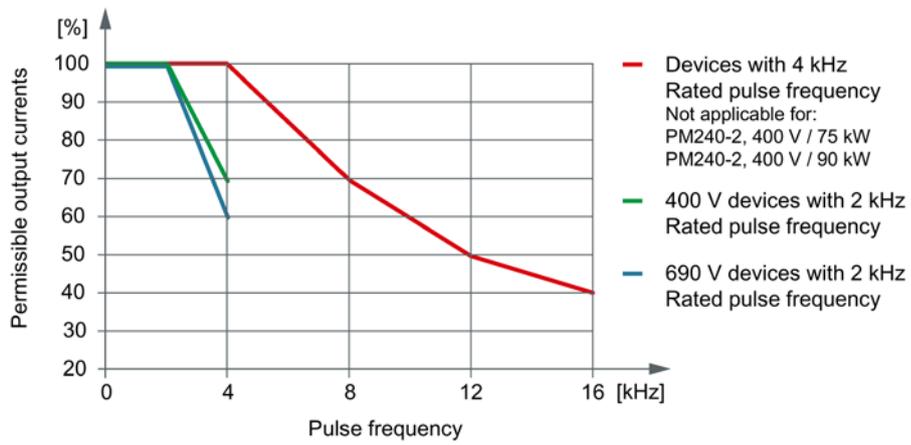


Figure 5-29 Reduction of the output current as a function of the pulse frequency

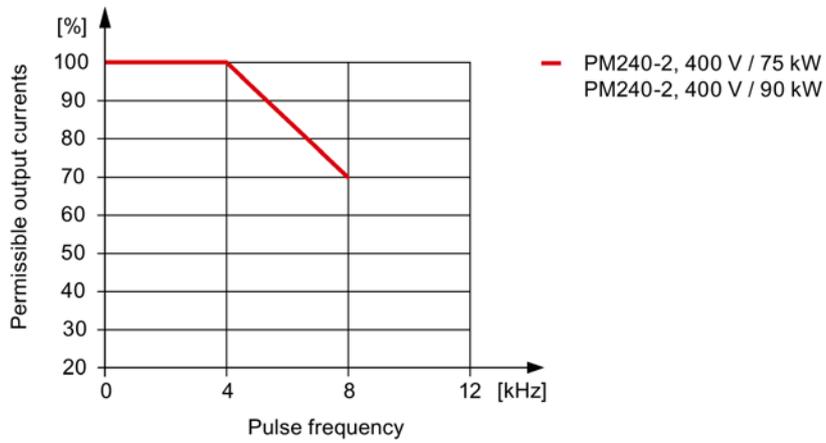


Figure 5-30 Reduction of the output current as a function of the pulse frequency (for PM240-2; 400 V, 75 and 90 kW)

Derating as a function of the output frequency

Power Modules blocksize format (FSA to FSC)

If the Power Modules are operated at an output frequency < 22 Hz, then you must reduce the output currents I_n , I_H , I_{S6} and I_{max} as follows:

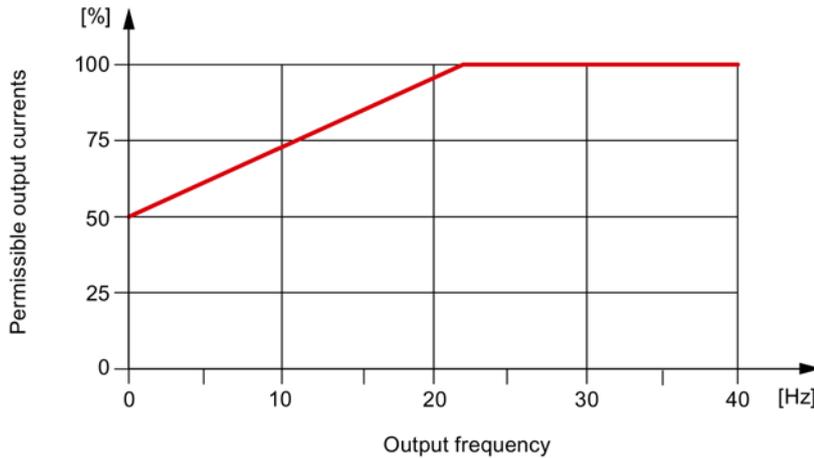


Figure 5-31 Reduction of the output current as a function of the output frequency

Power Modules blocksize (FSD to FSG)

If the Power Modules are operated at an output frequency < 10 Hz, then you must reduce the output currents I_n , I_H , I_{S6} and I_{max} as follows:

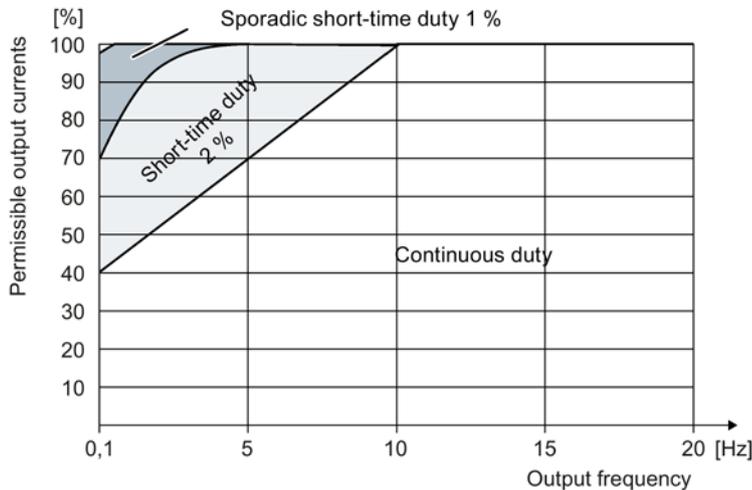


Figure 5-32 Reduction of the output current as a function of the output frequency

Continuous operation	Permissible operating state for the complete operating time
Short-time duty	Operating state permissible for less than 2% of the operating time
Sporadic short-time duty	Operating state permissible for less than 1% of the operating time

5.2.9.2 Overload capability

Overload capability is the property of the Power Module to temporarily supply a current that is higher than the rated current to accelerate a motor. Typical load cycles are defined to clearly demonstrate overload capability: "Low Overload" and "High Overload"

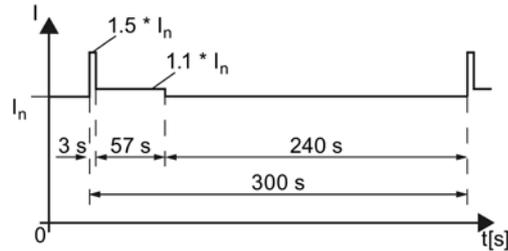


Figure 5-33 300 s load cycle based on Low Overload

Note

In previous documentation, rated current I_n was called I_L (base load current for low overload).

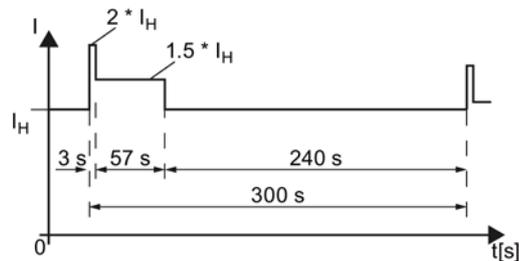


Figure 5-34 300 s load cycle based on High Overload

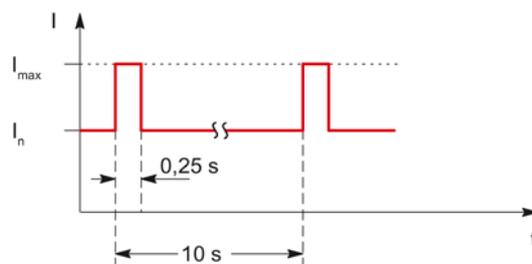


Figure 5-35 Duty cycle with initial load (for servo drives)

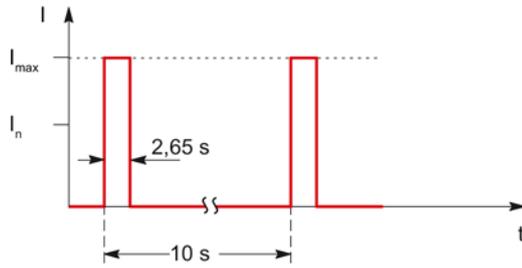


Figure 5-36 Duty cycle without initial load (for servo drives)

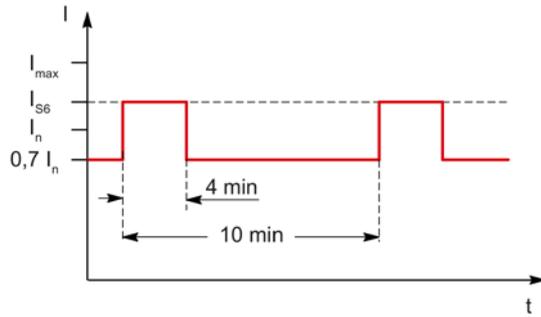


Figure 5-37 S6 duty cycle with pre-load condition

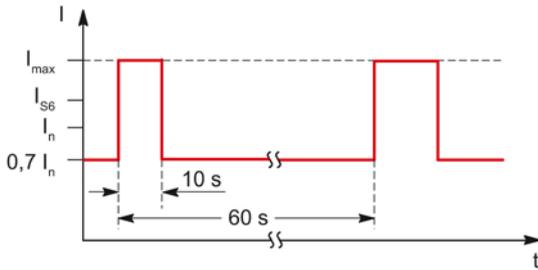


Figure 5-38 S6 peak current load cycle with pre-load condition

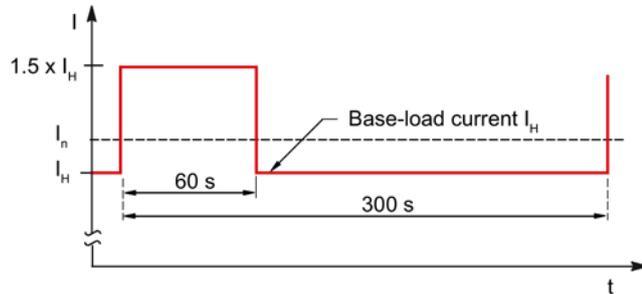


Figure 5-39 Duty cycle with 60 s overload with a duty cycle duration of 300 s

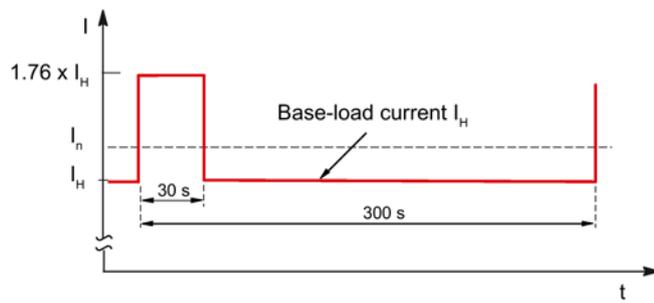


Figure 5-40 Duty cycle with 30 s overload with a duty cycle duration of 300 s

Note

The short leading edges of the duty cycles shown can only be achieved using speed or torque control.

5.3 Power Modules Chassis

5.3.1 Description

A Power Module is a power unit (frequency inverter) that provides the power supply for the connected motor. A Power Module must be connected to a Control Unit via DRIVE-CLiQ. The open-loop and closed-loop control functions are stored in the Control Unit.

Characteristics of Power Modules

- Version from 210 A to 490 A
- Internal air cooling
- Short-circuit/ground-fault-proof
- Electronic type plate
- Operating status and error status displayed using LEDs
- DRIVE-CLiQ interface for communication with the Control Unit and/or other components in the drive line-up
- Integration in system diagnostics

5.3.2 Interface description

5.3.2.1 Overview

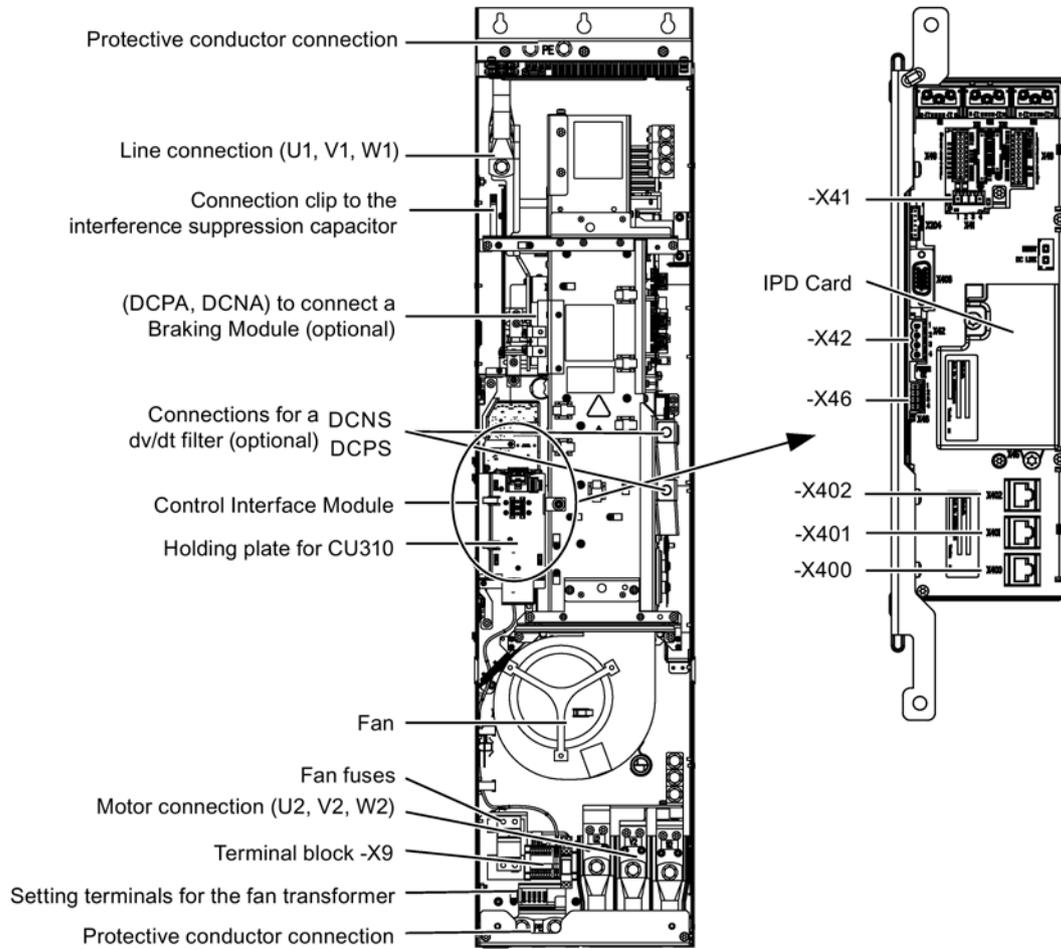


Figure 5-41 Power Module, frame size FX

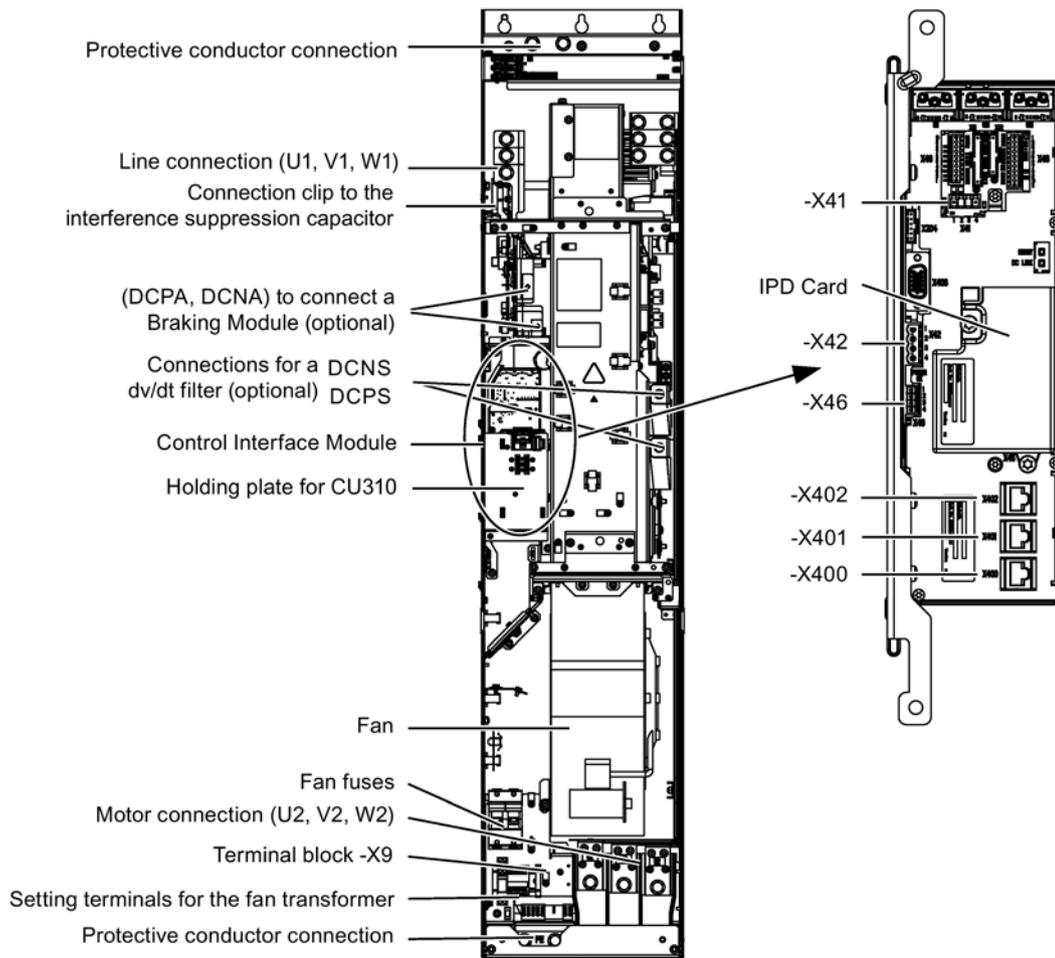
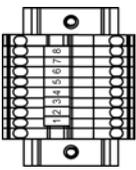


Figure 5-42 Power Module, frame size GX

5.3.2.2 Terminal Block X9

Table 5- 44 Terminal block X9

	Terminal	Signal name	Technical data
	1	P24V	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: max 1.4 A
	2	M	
	3	Reserved, do not use	-
	4	Reserved, do not use	-
	5	Main contactor	240 V AC/ max. 8 A 30 V DC/ max. 1 A
	6	Main contactor	
	7	EP +24 V (Enable Pulses)	Supply voltage: 24 V DC (20.8 V ... 28.8 V) Current consumption: 10 mA The pulse inhibit function is only available when Safety Integrated Basic Functions are enabled.
	8	EP M1 (Enable Pulses)	

Note

If the "Safe Torque Off" function is selected, 24 V DC must be applied to terminal -X9:7 and terminal -X9:8 must be grounded. Upon removal, pulse inhibit is activated.

5.3.2.3 DCPS, DCNS connection for a dv/dt filter

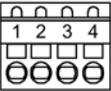
Table 5- 45 DCPS, DCNS

Frame size	Cross-section that can be connected	Connecting screw
FX	1 x 35 mm ² (AWG 2)	M8
GX	1 x 70 mm ² (AWG 2/0)	M8

The connecting cable is fed-out downwards through the Power Module.

5.3.2.4 X41 EP terminal / temperature sensor connection

Table 5- 46 Terminal block -X41

	Terminal	Function	Technical data
	1	EP M1 (enable pulses)	Supply voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: 10 mA
	2	EP +24 V (Enable Pulses)	
	3	-Temp	Temperature sensor KTY84-130 / PTC / Pt100 / Pt1000
	4	+Temp	
Max. connectable cross-section: 1.5 mm ² (AWG 16)			


! WARNING
Electric shock in the event of voltage flashovers at the temperature sensor

Voltage arcs to the signal electronics can occur for motors without electrical separation of the temperature sensors.

- Only use temperature sensors that fully comply with the specifications of the safety isolation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

NOTICE
Device failure due to unshielded or incorrectly laid cables to the temperature sensors

Unshielded or incorrectly laid cables to the temperature sensors can cause induced voltages from the power side to the signal-processing electronics. This can cause massive interferences of all signals (error messages) through to the failure of individual components (damage of the devices).

- Use only shielded cables to the temperature sensors.
- If cables to temperature sensors are laid together with the motor cable, use twisted pairs and separately shielded cables.
- Connect the cable shield to ground potential through a large surface area.
- Recommendation: Use suitable MOTION-CONNECT cables.

NOTICE
Damage to motor due to incorrectly connected KTY temperature sensor

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

- Connect a KTY temperature sensor with the correct polarity.

Note

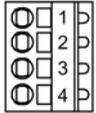
The temperature sensor connection can be used for motors that are equipped with a KTY84-130-, PTC, Pt100 or Pt1000 sensor in the stator windings.

Note

A cable harness is used to connect terminals -X41:1 and -X41:2 to terminals -X9:8 and -X9:7.

5.3.2.5 X42 terminal strip

Table 5- 47 Terminal block -X42:

	Terminal	Function	Technical data
	1	P24L	Power supply for Control Unit, Sensor Module and Terminal Module (18 to 28.8 V) Maximum load current: 3 A
	2		
	3	M	
	4		
Max. connectable cross-section: 2.5 mm ² (AWG 14)			

Note

When delivered, terminals 1 and 4 are provided with a connecting cable to supply a CU310-2 DP or CU310-2 PN Control Unit.

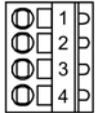
Note

Connection options for the X42 terminal strip

The terminal block is not intended for free 24 V DC availability (for example for supplying additional line-side components), as the voltage supply of the Control Interface Module could also be overloaded and therefore the operating capability could be compromised.

5.3.2.6 X46 Brake control and monitoring

Table 5- 48 Terminal block -X46

	Terminal	Function	Technical data
	1	BR output +	This interface is intended for the connection of the Safe Brake Adapter.
	2	BR output -	
	3	FB input +	
	4	FB input -	
Max. connectable cross-section: 1.5 mm ² (AWG 16)			

Note

For further information, see Section Safe Brake Adapter optional module (Page 342).

⚠ WARNING

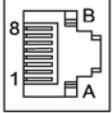
Fire due to overheating resulting from excessively long connecting cables

Excessively long connection cables on terminal strip X46 can cause components to overheat with the associated risk of fire and smoke.

- A maximum cable length of 10 m must not be exceeded.
- The cable must not be brought outside the control cabinet or control cabinet group.

5.3.2.7 DRIVE-CLiQ interface X400-X402

Table 5- 49 DRIVE-CLiQ interface X400-X402

	Pin	Name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground

5.3.2.8 Meaning of the LEDs on the Power Module

Table 5- 50 Meaning of the LEDs "READY" and "DC LINK" on the Control Interface Module on the Power Module

LED state		Description
READY	DC LINK	
Off	Off	The electronics power supply is missing or outside the permissible tolerance range.
Green	Off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is present.
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC-link voltage is too high.
Orange	Orange	DRIVE-CLiQ communication is being established.
Red	---	At least one fault is present in this component. Note: The LED is activated irrespective of whether the corresponding messages have been reconfigured.
Green/Red (0.5 Hz)	---	Firmware is being downloaded.
Green/Red (2 Hz)	---	Firmware download is complete. Wait for POWER ON.
Green/orange or red/orange	---	Recognition of the component via LED is activated (see SINAMICS S120/S150 List Manual.) Remark: Both options depend on the LED status when component recognition is activated using the parameter.



 WARNING
<p>Electric shock when live parts of the DC link are touched</p> <p>Irrespective of the state of the LED "DC LINK", hazardous DC link voltages can be present. Contact with live parts can result in death or serious injury.</p> <ul style="list-style-type: none"> • Observe the warning information on the component.

Table 5- 51 Meaning of the LED "POWER OK" on the Control Interface Module in the Power Module

LED	Color	Status	Description
POWER OK	Green	Off	DC-link voltage < 100 V and voltage at –X9:1/2 less than 12 V.
		On	The component is ready for operation.
		Flashing	There is a fault. If the LED continues to flash after you have performed a POWER ON, please contact your Siemens service center.

5.3.3 Connection example

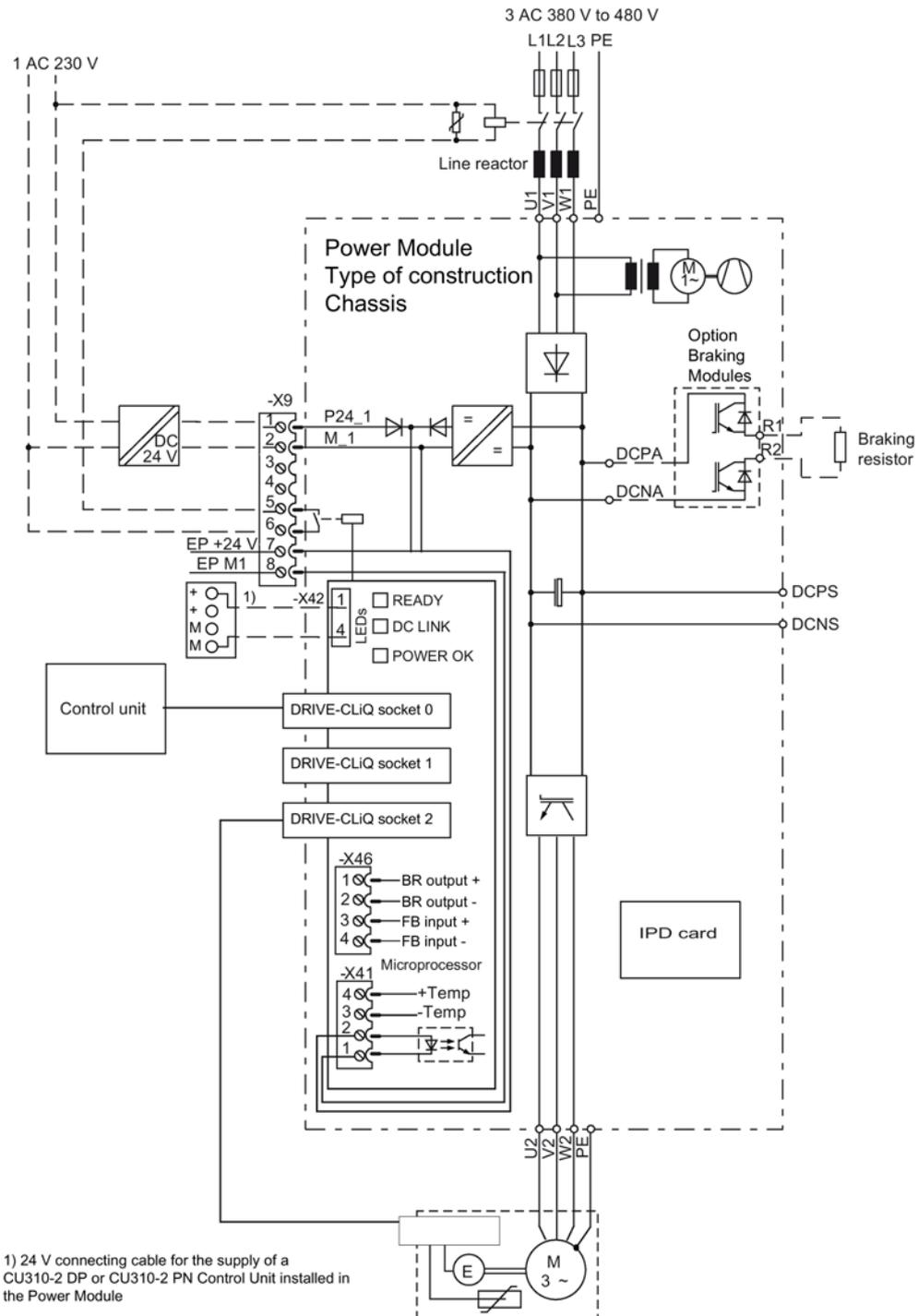


Figure 5-43 Connection example: Power Module chassis

5.3.4 Dimension drawings

Dimension drawing frame size FX

The cooling clearances to be maintained are indicated by the dotted line.

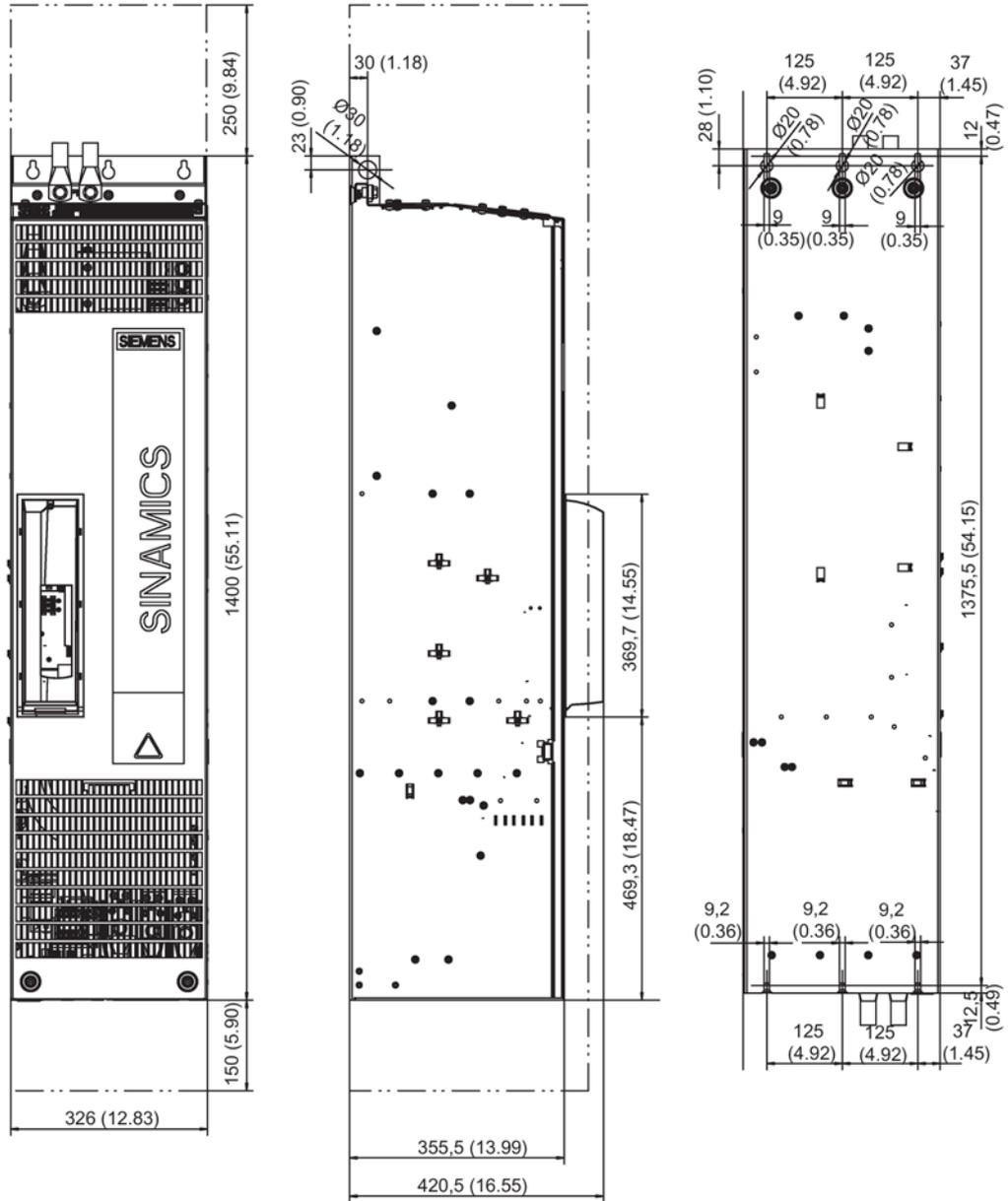


Figure 5-44 Dimension drawing Power Module, frame size FX

Dimension drawing frame size GX

The cooling clearances to be maintained are indicated by the dotted line.

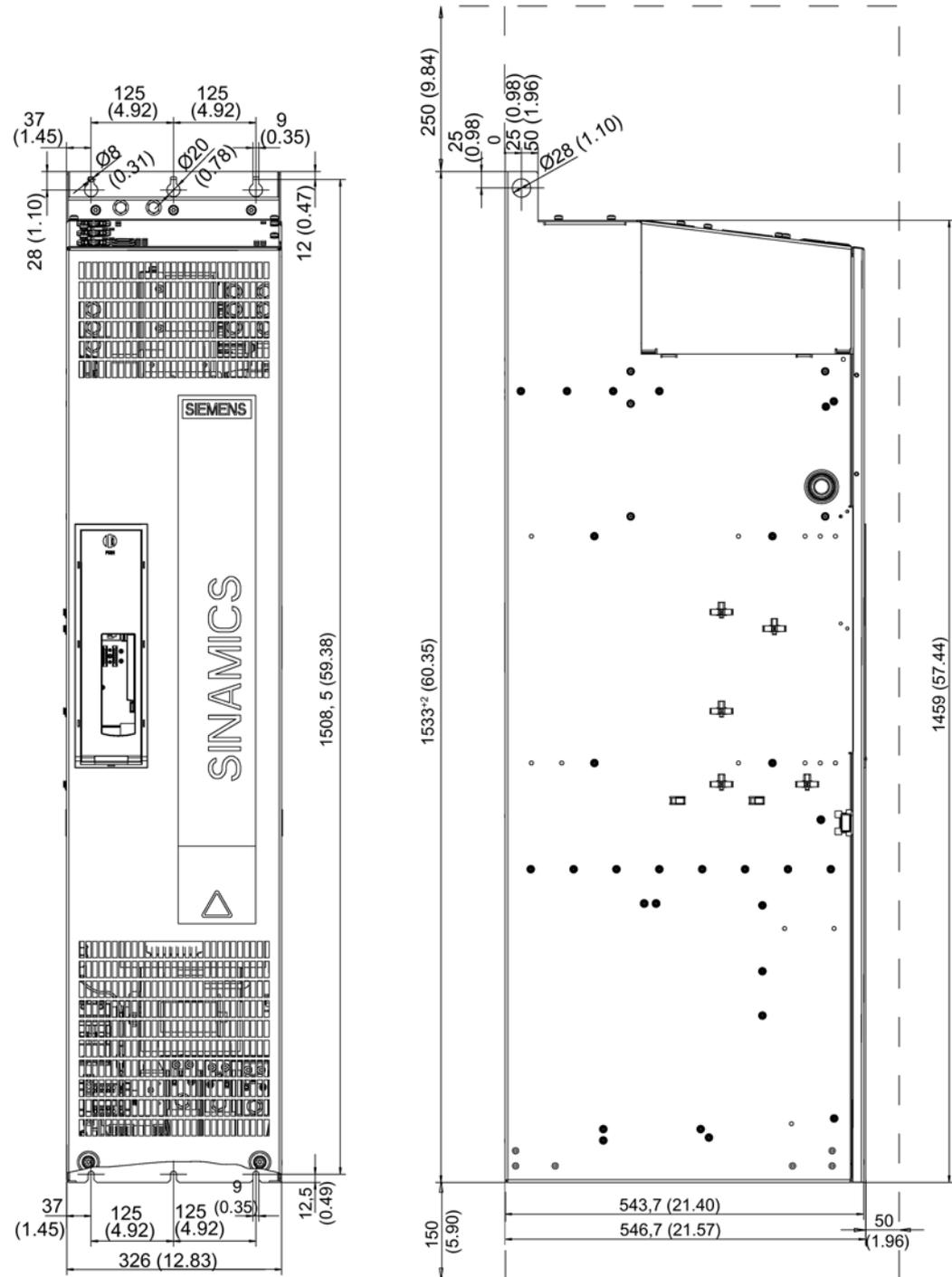


Figure 5-45 Dimension drawing Power Module, frame size GX

5.3.5 Electrical connection

Adjusting the fan voltage (-T10)

The power supply for the device fans (1-phase 230 VAC) in the Power Module (-T10) is taken from the line supply using a transformer. The mounting position of the transformer is shown in the interface descriptions.

The transformers are fitted with primary taps so that they can be fine-tuned to the line voltage. When delivered, the taps are always set to the highest level. With a low supply voltage, the appropriate transformer tap must be activated.

The connections at the setting terminals must be connected to "0" and the line voltage.

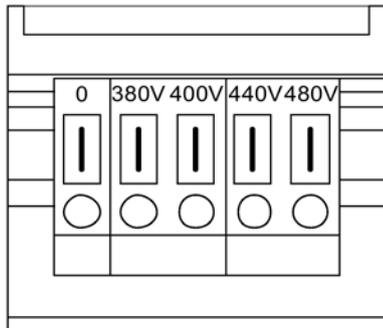


Figure 5-46 Setting terminals for the fan transformers

The supply voltage assignments for making the appropriate setting on the fan transformer are indicated in the following table (factory presetting): 480 V/0 V)

 WARNING
<p>Fire due to overheating resulting from insufficient equipment fan voltage</p> <p>If the terminals are not reconnected to the actual line voltage, overheating and human danger due to smoke and fire may result. Moreover, the fan fuses may blow due to overload.</p> <ul style="list-style-type: none"> Assign the terminals in accordance with the actual line voltage.

Table 5- 52 Assignment of the existing line voltage for setting at the fan transformer

Line voltage	Tap at the fan transformer (-T10)
380 V ± 10%	380 V
400 V ± 10%	400 V
440 V ± 10%	440 V
480 V ± 10%	480 V

Removing the connection clip to the basic interference suppression module for operation on an ungrounded supply system (IT system)

If the Power Module is operated from a non-grounded line supply (IT system), the connection bracket to the basic interference suppression module of the Power Module must be removed.

The position of the connection clip can be seen in the overviews of the Power Modules.

Note

Warning label on the connection clip

A yellow warning label is attached to each connection clip so that it is easier to find.

- The warning label must be removed from the connection clip (by pulling it off) if the connection clip is to remain in the unit (operation on a grounded line supply).
- The warning label must be removed together with the connection clip if the unit is operated on a non-grounded line supply (IT supply system).



Figure 5-47 Warning label on the connection clip

NOTICE

Damage to the device through not removing the connection clip with a non-grounded line supply

Failure to remove the connection clip to the basic interference suppression module on a non-grounded line supply (IT system) can cause significant damage to the device.

- With a non-grounded line supply (IT system), remove the connection clip to the basic interference suppression module.

5.3.6 Technical data

Table 5- 53 Technical data, Power Modules Chassis

Line voltage 3-ph. 380 V to 480 V AC $\pm 10\%$ (-15% < 1 min)						
Article number	6SL3310-	1TE32-1AA3	1TE32-6AA3	1TE33-1AA3	1TE33-8AA3	1TE35-0AA3
Frame size		FX	FX	GX	GX	GX
Output current						
rated current I_n	A	210	260	310	380	490
base load current I_L	A	205	250	302	370	477
base load current I_H	A	178	233	277	340	438
for S6 duty (40 %) I_{S6}	A	230	285	340	430	540
peak current I_{max}	A	307	375	453	555	715
Supply voltages						
Electronics power supply	V_{DC}	24 (20.4 ... 28.8)				
Overvoltage trip	V_{DC}	$820 \pm 2\%$				
Undervoltage trip	V_{DC}	424				
Type rating¹⁾ based on I_n / based on I_H	kW	110 / 90	132 / 110	160 / 132	200 / 160	250 / 200
Rated pulse frequency						
without derating	kHz	2	2	2	2	2
with derating	kHz	8	8	8	8	8
Power loss	kW	2.46	3.27	4.0	4.54	5.78
Cooling air requirement	m ³ /s	0.17	0.23	0.36	0.36	0.36
Sound pressure level at 50 / 60 Hz	dB(A)	66 / 67	71 / 71	68 / 72	68 / 72	68 / 72
Rated input current	A	229	284	338	395	509
Current requirement²⁾ at 24 V DC, max.	A	0.8	0.8	0.9	0.9	0.9
Line supply connection U1, V1, W1		Flat connector for M10 cable lug, max. Connection cross-section 2 x 185 mm ²		Flat connector for M10 cable lug, max. Connection cross-section 2 x 240 mm ²		
Motor connection U2, V2, W2		Flat connector for M10 cable lug, max. Connection cross-section 2 x 185 mm ²		Flat connector for M10 cable lug, max. Connection cross-section 2 x 240 mm ²		
DC link connections DCPA, DCNA, (option, Braking Module)		Flat connector for M6 cable lug, conductor cross-section 1 x 35 mm ²		Flat connector for M6 cable lug, conductor cross-section 1 x 50 mm ²		
DC link connections DCPS, DCNS (option, dv/dt filter)		Flat connector for M8 cable lug, conductor cross-section 1 x 35 mm ²		Flat connector for M8 cable lug, conductor cross-section 1 x 70 mm ²		
Protective conductor connection		Flat connector for M10 cable lug, max. Connection cross-section 2 x 185 mm ²		Flat connector for M10 cable lug, max. Connection cross-section 2 x 240 mm ²		
Max. motor cable length³⁾	m	300 (shielded) / 450 (unshielded)				

Line voltage 3-ph. 380 V to 480 V AC $\pm 10\%$ ($-15\% < 1 \text{ min}$)						
Article number	6SL3310-	1TE32-1AA3	1TE32-6AA3	1TE33-1AA3	1TE33-8AA3	1TE35-0AA3
Max. ambient temperature	without derating	°C	40	40	40	40
	with derating	°C	55	55	55	55
Degree of protection		IP 20 or IPXXB				
Width	mm	326	326	326	326	326
Height	mm	1400	1400	1533	1533	1533
Depth	mm	356 ⁴⁾	356 ⁴⁾	545	545	545
Weight	kg	104	104	162	162	162

- 1) Rated power of a typical standard induction motor at 400 V 3 AC
- 2) Current consumption of Power Module only. If a Control Unit is supplied with 24 V DC from the Power Module, its current consumption must be added.
- 3) Max. motor cable length 100 m (shielded) in conjunction with a line filter to comply with the EMC limit values of EN 61800-3 Category C2.
- 4) Depth = 421 mm including front cover when a Control Unit is installed

5.3.7 Characteristics

5.3.7.1 Current derating

Derating as a function of the ambient temperature and installation altitude

Air-cooled SINAMICS S120 chassis format units and the associated system components are rated for an ambient temperature of 40 °C and installation altitudes up to 2000 m above sea level.

The output current must be reduced for ambient temperatures > 40 °C. Ambient temperatures above 55 °C are not permissible.

At installation altitudes > 2000 m above sea level, it must be taken into account that the air pressure, and therefore air density, decreases as the height increases. This reduces the cooling effect as well as the insulating strength of the air.

Due to the reduced cooling efficiency, it is necessary, on the one hand, to reduce the ambient temperature and on the other hand, to reduce the heat loss in the built-in unit by reducing the output current, whereby ambient temperatures lower than 40 °C may be offset to compensate.

The following table specifies the permissible output currents as a function of the installation altitude and ambient temperature. The specified values already include the permissible compensation in respect of installation altitude and ambient temperatures < 40 °C – temperature at the air intake of the chassis unit.

The values apply under the precondition that a cooling air flow through the devices is ensured as specified in the technical data.

As additional measure for installation altitudes from 2000 m up to 5000 m, an isolating transformer is required in order to reduce transient overvoltages according to EN 60664-1.

Table 5- 54 Reduction of the output current as a function of the installation altitude and the ambient temperature

Installation altitude above mean sea level	Output current (as a % of the rated current) for an ambient temperature of							
	20 °C	25 °C	30 °C	35 °C	40 °C	45 °C	50 °C	55 °C
m								
0 ... 2000	100	100	100	100	100	93.3	86.7	80.0
> 2000 ... 2500	100	100	100	100	96.3			
> 2500 ... 3000	100	100	100	98.7				
> 3000 ... 3500	100	100	100					
> 3500 ... 4000	100	100	96.3					
> 4000 ... 4500	100	97.5						
> 4500 ... 5000	98.2							

Derating as a function of the output frequency

Power Modules chassis format

If the Power Modules are operated at an output frequency < 10 Hz, then you must reduce the output currents I_n , I_H , I_{S6} and I_{max} as follows:

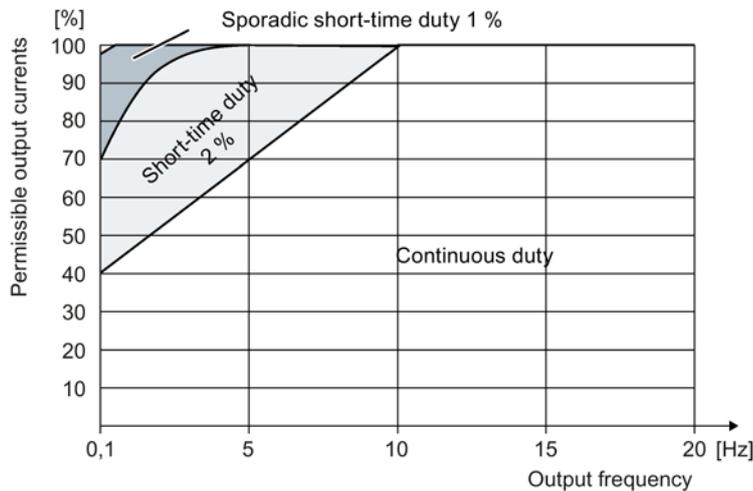


Figure 5-48 Reduction of the output current as a function of the output frequency

- Continuous duty Permissible operating state for the complete operating time
- Short-time duty Operating state permissible for less than 2 % of the operating time
- Sporadic short-time duty Operating state permissible for less than 1 % of the operating time

5.3.7.2 Overload capability

The Power Modules are equipped with an overload reserve, e.g. to handle breakaway torques.

In drives with overload requirements, the appropriate base load current must, therefore, be used as a basis for the required load.

The overload data is valid under the precondition that the Power Module is operated with its base load current before and after the overload occurs (a load duration of 300 s is used as a basis here).

Low overload

The base load current for low overload I_L is based on a load duty cycle of 110% for 60 s or 150% for 10 s with a load duty duration of 300 s.

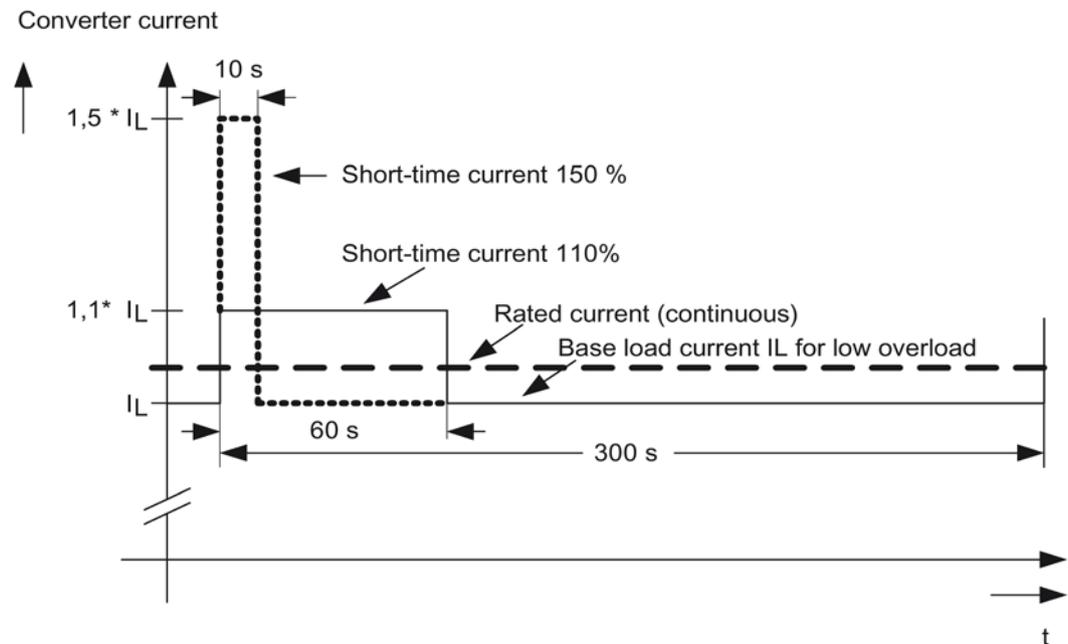


Figure 5-49 Characteristic: Low overload

High overload

The base load current for high overload I_H is based on a load duty cycle of 150% for 60 s or 160% for 10 s with a load duty duration of 300 s.

Converter current

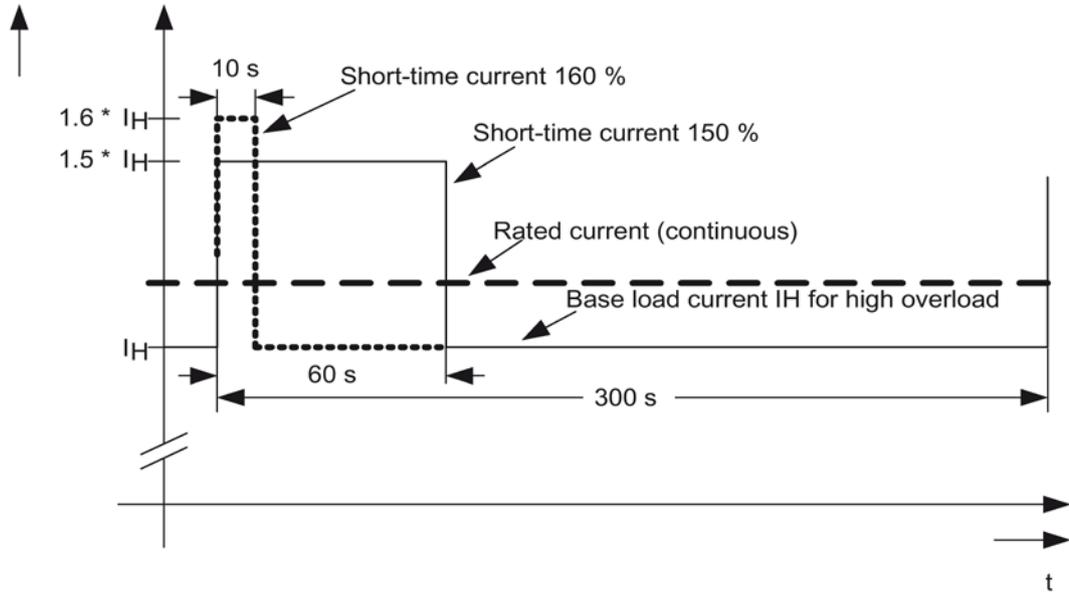


Figure 5-50 Characteristic: High overload

DC link components

6.1 Blocksize

6.1.1 Braking resistors

6.1.1.1 Description

The PM240-2 Power Modules cannot feed back regenerated energy into the line supply. For regenerative operation, e.g. the braking of a rotating mass, a braking resistor must be connected to convert the resulting energy into heat.

A thermostatic switch monitors the braking resistor for overtemperature and issues a signal on an isolated contact if the limit value is exceeded.

6.1.1.2 Safety instructions for blocksize braking resistors

 WARNING
Fire and device damage as a result of ground fault/short-circuit
The cables to the braking resistor must be routed so that a ground fault or short circuit can be ruled out. A ground fault can result in fire with associated smoke.
<ul style="list-style-type: none">• Comply with local installation regulations, which allow this fault to be ruled out.• Protect the cables from mechanical damage.• In addition, apply one of the following measures:<ul style="list-style-type: none">– Use cables with double insulation.– Observe adequate clearances, e.g. through the use of spacers.– Route the cables in separate cable ducts or pipes.



 CAUTION
Burns or damage resulting from the high surface temperature of the braking resistor
The braking resistor can become very hot. You can be severely burnt when touching the surface. Neighboring components can become damaged.
<ul style="list-style-type: none">• Mount the braking resistor so that it cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.• To avoid temperature-related damage to adjacent components, follow these rules:<ul style="list-style-type: none">– Mount the resistor on a heat resistant surface with a high thermal conductivity.For PM240-2 Power Modules FSA, FSB and FSC installed horizontally close to the ground:<ul style="list-style-type: none">– Installation on sheet steel > 2 mm– Ensure a ventilation clearance of 250 mm at the sides of the braking resistor– Ventilation clearance of 1000 mm above the braking resistorFor PM240-2 Power Modules FSA, FSB and FSC when installed vertically against a wall or panel:<ul style="list-style-type: none">– Installation on sheet steel > 2 mm– Ensure a ventilation clearance of 100 mm at the sides of the braking resistor– Ventilation clearance of 1000 mm above the braking resistorFor PM240-2 FSD, FSE, FSF and FSG Power Modules:<ul style="list-style-type: none">– Observe the data provided in the braking resistor documentation

NOTICE
Damage to braking resistor due to ingress of water
If the heat generated by the brake resistor is not dissipated then this can result in damage.
<ul style="list-style-type: none">• Do not cover the ventilation openings of the braking resistor.

6.1.1.3 Connection examples

The braking resistor is connected directly on the Power Module at the terminals R1 and R2.

The braking resistor must be protected against overheating. This protection function performs the function of a thermostatic switch. The thermostatic switch is included in the scope of supply of the braking resistor. Evaluate the braking resistor temperature monitoring so that the motor is switched off when the resistor is in an overtemperature condition.

Connect the thermostatic switch to a Control Unit

Connect the thermostatic switch to a free digital input of the Control Unit. Set the function of this digital input to the OFF2 command. If the braking resistor overheats, the Power Module is disconnected from the power supply.

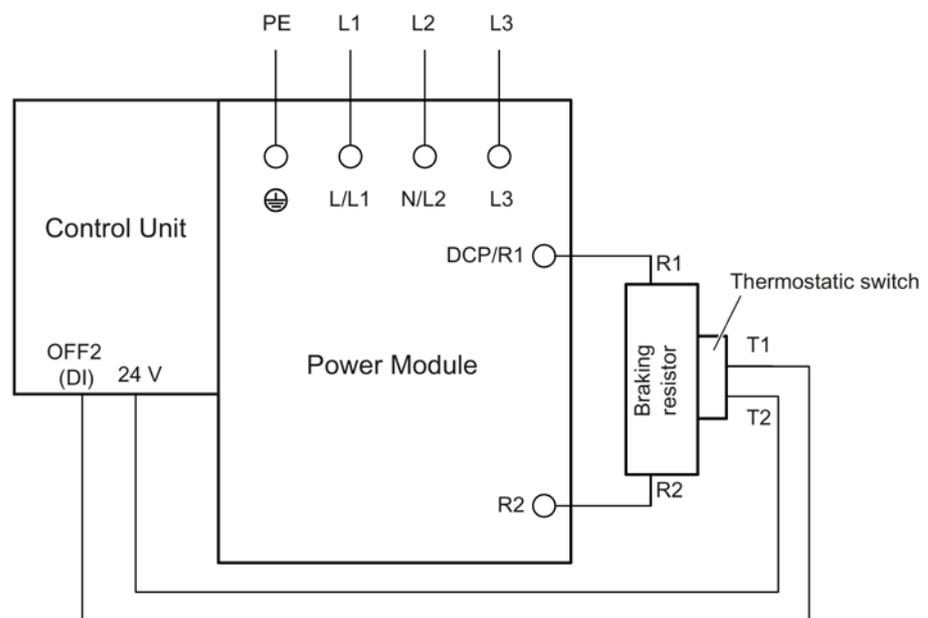


Figure 6-1 Connecting the thermostatic switch on the braking resistor to a Control Unit

6.1.1.4 Dimension drawings

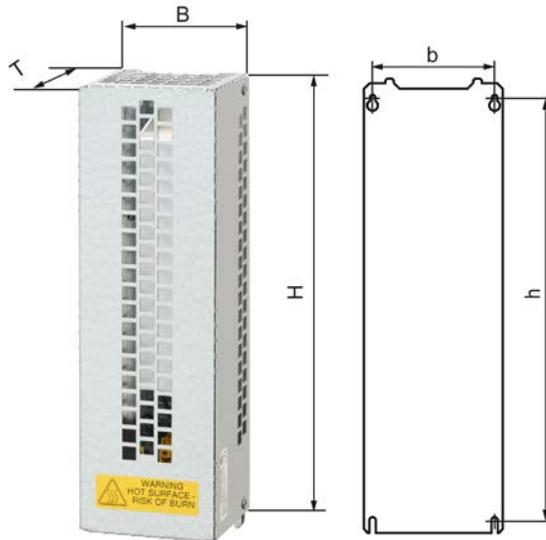


Figure 6-2 Dimension drawing and drilling pattern for blocksize braking resistors

Table 6- 1 Dimensions, braking resistors for PM240-2 Power Modules

Frame size	Article number		Total dimensions			Drilling dimensions	
			H	B	T	h	b
For 200 V converters:							
FSA	JJY:023146720008	mm (inch)	295 (11.61)	105 (4.13)	100 (3.94)	266 (10.47)	72 (2.84)
FSB	JJY:023151720007	mm (inch)	345 (13.58)	105 (4.13)	100 (3.94)	316 (12.44)	72 (2.84)
FSC	JJY:023163720018	mm (inch)	345 (13.58)	175 (6.89)	100 (3.94)	316 (12.44)	142 (5.59)
FSC	JJY:023433720001	mm (inch)	490 (19.29)	250 (9.84)	140 (5.51)	460 (18.11)	217 (8.54)
FSD	JJY:023422620002	mm (inch)	470 (18.50)	220 (8.66)	180 (7.09)	430 (16.93)	187 (7.36)
FSE	JJY:023423320001	mm (inch)	560 (22.05)	220 (8.66)	180 (7.09)	500 (19.69)	187 (7.36)
FSF	JJY:023434020003	mm (inch)	630 (24.80)	350 (13.78)	180 (7.09)	570 (22.44)	317 (12.48)
For 400 V converters:							
FSA	6SL3201-0BE14-3AA0	mm (inch)	295 (11.61)	105 (4.13)	100 (3.94)	266 (10.47)	72 (2.83)
FSA	6SL3201-0BE21-0AA0	mm (inch)	345 (13.58)	105 (4.13)	100 (3.94)	316 (12.44)	72 (2.83)
FSB	6SL3201-0BE21-8AA0	mm (inch)	345 (13.58)	175 (6.89)	100 (3.94)	316 (12.44)	142 (5.59)

Frame size	Article number		Total dimensions			Drilling dimensions	
			H	B	T	h	b
FSC	6SL3201-0BE23-8AA0	mm (inch)	490 (19.29)	250 (9.84)	140 (5.51)	460 (18.11)	217 (8.54)
FSD	JJY:023422620001	mm (inch)	470 (18.50)	220 (8.66)	180 (7.09)	430 (16.93)	187 (7.36)
FSD	JJY:023424020001	mm (inch)	610 (24.02)	220 (8.66)	180 (7.09)	570 (22.44)	187 (7.36)
FSE	JJY:023434020001	mm (inch)	630 (24.80)	350 (13.78)	180 (7.09)	570 (22.44)	317 (12.48)
FSF (FSD)	JJY:023454020001 ¹⁾ • JJY:023422620001	mm (inch)	470 (18.50)	220 (8.66)	180 (7.09)	430 (16.93)	187 (7.36)
(FSE)	• JJY:023434020001	mm (inch)	630 (24.80)	350 (13.78)	180 (7.09)	570 (22.44)	317 (12.48)
FSF (FSE)	JJY:023464020001 ¹⁾ • JJY:023434020001	mm (inch)	630 (24.80)	350 (13.78)	180 (7.09)	570 (22.44)	317 (12.48)
(FSE)	• JJY:023434020001	mm (inch)	630 (24.80)	350 (13.78)	180 (7.09)	570 (22.44)	317 (12.48)
FSG	6SL3000-1BE32-5AA0	mm (inch)	1325 (52.17)	740 (29.13)	485 (19.04)	-	-
For 690 V converters:							
FSD	JJY:023424020002	mm (inch)	610 (24.02)	220 (8.66)	180 (7.09)	570 (22.44)	187 (7.36)
FSE	JJY:023434020002	mm (inch)	630 (24.80)	350 (13.78)	180 (7.09)	570 (22.44)	317 (12.48)
FSF (FSE)	JJY:023464020002 ¹⁾ • JJY:023434020002	mm (inch)	630 (24.80)	350 (13.78)	180 (7.09)	570 (22.44)	317 (12.48)
(FSE)	• JJY:023434020002	mm (inch)	630 (24.80)	350 (13.78)	180 (7.09)	570 (22.44)	317 (12.48)
FSG	6SL3000-1BH32-5AA0	mm (inch)	1325 (52.17)	740 (29.13)	485 (19.04)	-	-

¹⁾ This braking resistor consists of 2 components, which must be connected in parallel on the plant/system side.

6.1.1.5 Installation

The braking resistor for all modules is connected at terminals R1 and R2. Since it generates heat, it should be mounted to the side of the Power Modules.

The braking resistors for the Power Modules, frame sizes FSD to FSG should be placed outside the control cabinet or the switchgear room in order to direct the resulting heat loss away from the Power Modules. This reduces the level of air conditioning required.

The braking resistors can be installed horizontally or vertically. The power connections on vertically installed resistors must be below.

Table 6- 2 Connecting the braking resistors for PM240-2 Power Modules on the mounting surface

Frame size	Article number	Fastening	Tightening torque
For 200 V converters:			
FSA	JJY:023146720008	4 x M4 screws ¹⁾	3 Nm (26.6 lbf in)
FSB	JJY:023151720007	4 x M4 screws ¹⁾	3 Nm (26.6 lbf in)
FSC	JJY:023163720018	4 x M4 screws ¹⁾	3 Nm (26.6 lbf in)
FSC	JJY:023433720001	4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSD	JJY:023422620002	4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSE	JJY:023423320001	4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSF	JJY:023434020003	4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
For 400 V converters:			
FSA	6SL3201-0BE14-3AA0	4 x M4 screws ¹⁾	3 Nm (26.6 lbf in)
FSA	6SL3201-0BE21-0AA0	4 x M4 screws ¹⁾	3 Nm (26.6 lbf in)
FSB	6SL3201-0BE21-8AA0	4 x M4 screws ¹⁾	3 Nm (26.6 lbf in)
FSC	6SL3201-0BE23-8AA0	4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSD	JJY:023422620001	4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSD	JJY:023424020001	4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSE	JJY:023434020001	4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSF	JJY:023454020001 ²⁾	2 x 4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSF	JJY:023464020001 ³⁾	2 x 4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSG	6SL3000-1BE32-5AA0	4 x M10 bolts	50 Nm (443 lbf in)
For 690 V converters:			
FSD	JJY:023424020002	4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSE	JJY:023434020002	4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSF	JJY:023464020002 ⁴⁾	2 x 4 x M5 screws ¹⁾	6 Nm (53.1 lbf in)
FSG	6SL3000-1BH32-5AA0	4 x M10 bolts	50 Nm (443 lbf in)

1) Always use the screw together with nut and washer.

2) This braking resistor consists of components JJY:023422620001 and JJY:023434020001, which must be connected in parallel on the plant/system side.

3) This braking resistor consists of 2 components JJY:023434020001, which must be connected in parallel on the plant/system side.

4) This braking resistor consists of 2 components JJY:023434020002, which must be connected in parallel on the plant/system side.

Note**Protective conductor connection**

The protective conductor connection for the braking resistor is established via the shield connection for frame sizes FSA to FSC.

For installation according to EN 60204-1 and EN 61800-5-1, the protective conductor connection at the housing must be used. The protective cable conductor in the pigtail is, in this case, not to be used, but can be suitably tied off or cut off.

For frame sizes FSD to FSF, the protective conductor connection of the braking resistor is connected at the sheet steel enclosure above terminals R1 and R2. Optionally, additional shield connecting plates can be ordered from Siemens.

6.1.1.6 Technical data**Line voltage 1/3 AC 200 V to 240 V ±10 %****Note**

Additional combinations are possible through our "Siemens Product Partners for Drive Options (<https://w3.siemens.com/mcms/mc-drives/de/niederspannungsumrichter/sinamics-zubehoer/Seiten/sinamics-zubehoer.aspx>)".

Note**Braking resistors FSD ... FSF**

Only use braking resistors that are UL approved, and have successfully passed the "Abnormal Operation Test" according to UL 508.

Table 6- 3 Braking resistors for Blocksize PM240-2, 200 V, FSA - FSC

Manufacturer		Heine Resistors GmbH			
Article number JJY:023...		146720008	151720007	163720018	433720001
Resistance	Ω	200	68	37	20
Type rating P _{DB}	kW	0.0375	0.11	0.20	0.375
Peak power P _{max}	kW	0.75	2.2	4.0	7.5
Load duration for peak power T _a	s	12	12	12	12
Period duration of braking duty cycle T	s	240	240	240	240
Degree of protection		IP20	IP20	IP20	IP20

6.1 Blocksize

Manufacturer		Heine Resistors GmbH			
Article number JJY:023...		146720008	151720007	163720018	433720001
Power connections (including protective conductor) Max. cross-section that can be connected: Tightening torque:		2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	4.0 mm ² (AWG 12) 0.5 Nm (4.4 lbf in)	6.0 mm ² (AWG 10) 0.8 Nm (7.1 lbf in)	6.0 mm ² (AWG 10) 0.8 Nm (7.1 lbf in)
Thermostatic switch Max. connectable cross-section: Tightening torque:		2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)
Thermostatic switch (NC contact) Maximum contact load connecting cable		250 V AC / 2.5 A	250 V AC / 2.5 A	250 V AC / 2.5 A	250 V AC / 2.5 A
Weight	kg	0.5	0.7	1.1	2.2
Matching Power Modules ¹⁾		6SL3210- 1PB13-0□L0 1PB13-8□L0 6SL3211- 1PB13-8□L0	6SL3210- 1PB15-5□L0 1PB17-4□L0 1PB21-0□L0 6SL3211- 1PB21-0□L0	6SL3210- 1PB21-4□L0 1PB21-8□L0 6SL3211- 1PB21-8□L0	6SL3210- 1PC22-2□L0 1PC22-8□L0 6SL3211- 1PC22-2□L0 1PC22-8□L0
Frame size		FSA	FSB	FSC	FSC
Type rating of the Power Module	kW	0.55 ... 0.75	1.1 ... 2.2	3.0 ... 4.0	5.5 ... 7.5

1) □ = A: Power Module with integrated line filter, □ = U: Power Module without integrated line filter

Table 6- 4 Braking resistors for Blocksize PM240-2, 200 V, FSD - FSF, self-protecting

Manufacturer		Heine Resistors GmbH		
Article number JJY:023...		422620002	423320001	434020003
Resistance	Ω	7.5	4.5	2.5
Type rating P _{DB}	kW	0.93	1.5	2.75
Peak power P _{max}	kW	18.5	30	55
Load duration for peak power T _a	s	12	12	12
Period duration of braking duty cycle T	s	240	240	240
Degree of protection		IP21	IP21	IP21
Power connections (including protective conductor) Max. cross-section that can be connected: Tightening torque:		10 mm ² (AWG 8) 0.5 Nm (4.4 lbf in)	16 mm ² (AWG 6) 1.2 Nm (10.6 lbf in)	16 mm ² (AWG 6) 1.2 Nm (10.6 lbf in)
Thermostatic switch Max. connectable cross-section: Tightening torque:		2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)
Thermostatic switch (NC contact) Maximum contact load connecting cable		250 V AC / 2.5 A	250 V AC / 2.5 A	250 V AC / 2.5 A

Manufacturer		Heine Resistors GmbH		
Article number JJY:023...		422620002	423320001	434020003
Weight	kg	7.0	8.5	13.5
Suitable for Power Module		6SL3210- 1PC24-2UL0 1PC25-4UL0 1PC26-8UL0 6SL3211- 1PC26-8UL0	6SL3210- 1PC28-8UL0 1PC31-1UL0 6SL3211- 1PC31-1UL0	6SL3210- 1PC31-3UL0 1PC31-6UL0 1PC31-8UL0 6SL3211- 1PC31-8UL0
Frame size		FSD	FSE	FSF
Type rating of the Power Module	kW	11 ... 18.5	22 ... 30	37 ... 55

Line voltage 3 AC 380 V to 480 V $\pm 10\%$

Table 6- 5 Braking resistors for Blocksize PM240-2, 400 V, FSA - FSC

Article No. 6SL3201-		OBE14-3AA0	OBE21-0AA0	OBE21-8AA0	OBE23-8AA0
Resistance	Ω	370	140	75	30
Type rating P_{DB}	kW	0.075	0.2	0.375	0.925
Peak power P_{max}	kW	1.5	4	7.5	18.5
Load duration for peak power T_a	s	12	12	12	12
Period duration of braking duty cycle T	s	240	240	240	240
Degree of protection		IP20	IP20	IP20	IP20
Power connections (including protective conductor) Max. cross-section that can be connected: Tightening torque:		2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	4.0 mm ² (AWG 12) 0.7 Nm (6.2 lbf in)	6.0 mm ² (AWG 10) 3.0 Nm (26.6 lbf in)
Thermostatic switch Max. connectable cross-section: Tightening torque:		2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)
Thermostatic switch (NC contact) Maximum contact load connecting cable		250 V AC / 2.5 A	250 V AC / 2.5 A	250 V AC / 2.5 A	250 V AC / 2.5 A
Weight	kg	1.5	1.8	2.7	6.2
Matching Power Modules ¹⁾		6SL3210- 1PE11-8□L1 1PE12-3□L1 1PE13-2□L1 1PE14-3□L1	6SL3210- 1PE16-1□L1 1PE18-0□L0 6SL3211- 1PE18-0□L1	6SL3210- 1PE21-1□L0 1PE21-4□L0 1PE21-8□L0 6SL3211- 1PE21-8□L0	6SL3210- 1PE22-7□L0 1PE23-3□L0 6SL3211- 1PE23-3□L0

6.1 Blocksize

Article No. 6SL3201-		0BE14-3AA0	0BE21-0AA0	0BE21-8AA0	0BE23-8AA0
Frame size		FSA	FSA	FSB	FSC
Type rating of the Power Module	kW	0.55 ... 1.5	2.2 ... 3.0	5.5 ... 7.5	11 ... 15

1) □ = A: Power Module with integrated line filter, □ = U: Power Module without integrated line filter

Table 6- 6 Braking resistors for PM240-2 blocksize, 400 V, FSD - FSE, self-protecting

Manufacturer		Heine Resistors GmbH		
Article number JJY:023...		422620001	424020001	434020001
Resistance	Ω	25	15	10
Type rating P _{DB}	kW	1.1	1.85	2.75
Peak power P _{max}	kW	22	37	55
Load duration for peak power T _a	s	12	12	12
Period duration of braking duty cycle T	s	240	240	240
Degree of protection		IP21	IP21	IP21
Power connections (including protective conductor) Max. cross-section that can be connected: Tightening torque:		10 mm ² (AWG 8) 0.8 Nm (7.1 lbf in)	10 mm ² (AWG 8) 0.8 Nm (7.1 lbf in)	16 mm ² (AWG 6) 1.2 Nm (10.6 lbf in)
Thermostatic switch Max. connectable cross-section: Tightening torque:		2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)
Thermostatic switch (NC contact) Maximum contact load connecting cable		250 V AC / 2.5 A	250 V AC / 2.5 A	250 V AC / 2.5 A
Weight	kg	7.0	9.5	13.5
Matching Power Modules ²⁾		6SL3210- 1PE23-8□L0 1PE24-5□L0	6SL3210- 1PE26-0□L0 1PE27-5□L0 6SL3211- 1PE27-5□L0	6SL3210- 1PE28-8□L0 1PE31-1□L0 6SL3211- 1PE31-1□L0
Frame size		FSD	FSD	FSE
Type rating of the Power Module	kW	18.5 ... 22	30 ... 37	45 ... 55

1) 2 braking resistors must be connected in parallel.

2) □ = A: Power Module with integrated line filter, □ = U: Power Module without integrated line filter

Table 6- 7 Braking resistors for PM240-2 blocksize, 400 V, FSF - FSG (FSF self-protecting)

Manufacturer		Heine Resistors GmbH		
Article No.		JJY:023454020001 (JJY:023434020001 + JJY:023422620001) ¹⁾	JJY:023464020001 (2 x JJY:023434020001) ¹⁾	6SL3000-1BE32-5AA0
Resistance	Ω	7.1	5	2.2
Type rating P _{DB}	kW	3.85	5.5	12.5

Manufacturer		Heine Resistors GmbH		
Article No.		JJY:023454020001 (JJY:023434020001 + JJY:023422620001) ¹⁾	JJY:023464020001 (2 x JJY:023434020001) ¹⁾	6SL3000-1BE32-5AA0
Peak power P _{max}	kW	77	110	250
Load duration for peak power T _a	s	12	12	12
Period duration of braking duty cycle T	s	240	240	240
Degree of protection		IP21	IP21	IP00
Power connections (including protective conductor) Max. cross-section that can be connected: Tightening torque:		10 mm ² (AWG 8) 0.8 Nm (7.1 lbf in)	16 mm ² (AWG 6) 1.2 Nm (10.6 lbf in)	M10 stud terminal 50 Nm (443 lbf in)
Thermostatic switch Max. connectable cross-section: Tightening torque:		2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	70 mm ² (AWG 2/0) 25 Nm (221 lbf in)
Thermostatic switch (NC contact) Maximum contact load connecting cable		250 V AC / 2.5 A	250 V AC / 2.5 A	240 VAC / 10 A
Weight		kg	20.5	27
Matching Power Modules ²⁾		6SL3210- 1PE31-5□L0 1PE31-8□L0	6SL3210- 1PE32-1□L0 1PE32-5□L0 6SL3211- 1PE32-5□L0	6SL3210- 1PE33-0□L0 1PE33-7□L0 1PE34-8□L0
Frame size		FSF	FSF	FSG
Type rating of the Power Module		kW	75 ... 90	110 ... 132
				160 ... 250

1) 2 braking resistors must be connected in parallel.

2) FSF: □ = A: Power Module with integrated line filter, □ = U: Power Modules without integrated line filter
FSG: □ = A: Power Modules with integrated C2 line filter, □ = C: Power Modules with integrated C3 line filter

Line voltage 3 AC 500 V ... 690 V ±10 %

Table 6- 8 Braking resistors for PM240-2 blocksize, 690 V, FSD - FSG (FSD - FSF, self-protecting)

Manufacturer		Heine Resistors GmbH			
Article No.		JJY:02342402000 2	JJY:02343402000 2	JJY:02346402000 2 (2 x JJY:02343402000 2) ¹⁾	6SL3000-1BH32- 5AA0
Resistance	Ω	31	21	10.5 (21 21) ¹⁾	4.9
Type rating P _{DB}	kW	1.85	2.75	5.5 (2.75 + 2.75) ¹⁾	12.5
Peak power P _{max}	kW	37	55	110 (55 + 55) ¹⁾	250
Load duration for peak power T _a	s	12	12	12	12
Period duration of braking duty cycle T	s	240	240	240	240

6.1 Blocksize

Manufacturer		Heine Resistors GmbH			
Article No.		JJY:02342402000 2	JJY:02343402000 2	JJY:02346402000 2 (2 x JJY:02343402000 2) ¹⁾	6SL3000-1BH32-5AA0
Degree of protection		IP21	IP21	IP21	IP00
Power connections (including protective conductor) Tightening torque:		M5 bolts 6.0 Nm (53.1 lbf in)	M5 bolts 6.0 Nm (53.1 lbf in)	M5 bolts 6.0 Nm (53.1 lbf in)	M10 stud terminal 50 Nm (443 lbf in)
Thermostatic switch Max. connectable cross-section: Tightening torque:		2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	2.5 mm ² (AWG 14) 0.5 Nm (4.4 lbf in)	70 mm ² (AWG 2/0)) 25 Nm (221 lbf in)
Thermostatic switch (NC contact) Maximum contact load connecting cable		250 V AC / 2.5 A	250 V AC / 2.5 A	250 V AC / 2.5 A	240 VAC / 10 A
Weight		kg	9.5	13.5	27.0
Matching Power Modules ²⁾		6SL3210-1PH21-4□L0 1PH22-0□L0 1PH22-3□L0 1PH22-7□L0 1PH23-5□L0 1PH24-2□L0	6SL3210-1PH25-2□L0 1PH26-2□L0	6SL3210-1PH28-0□L0 1PH31-0□L0 1PH31-2□L0 1PH31-4□L0	6SL3210-1PH31-7CLO 1PH32-1CLO 1PH32-5CLO
Frame size		FSD	FSE	FSF	FSG
Type rating of the Power Module		kW	11 ... 37	45 ... 55	75 ... 132
					160 ... 250

1) 2 braking resistors must be connected in parallel.

2) □ = A: Power Module with integrated line filter, □ = U: Power Module without integrated line filter

Duty cycles

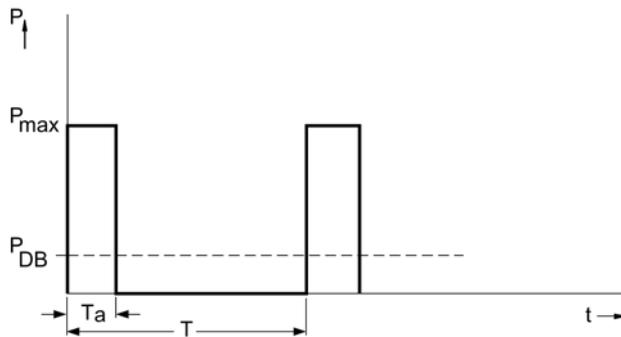


Figure 6-3 Load diagram for the braking resistor, in Blocksize format

T [s]: Period duration of braking duty cycle

T_a [s]: Duration of load with peak power

P_{DB} [kW]: Unit rating of the braking resistor

P_{max} [kW]: Peak power of the braking resistor

6.2 Chassis

6.2.1 Braking Modules

6.2.1.1 Description

A Braking Module (and an external braking resistor) is required in certain cases when the drive is to be braked or brought to a standstill (e.g. EMERGENCY SWITCHING-OFF Category 1). The Braking Module contains the power electronics and the associated control. The supply voltage for the electronics is taken from the DC link.

During operation, the DC link energy is converted to heat loss in an external braking resistor.

A mounting slot is provided in the Power Module.

Design

The Braking Module in chassis format is installed in a slot within the Power Module and force-cooled by its fan. The Braking Module is connected to the DC link by means of flexible cables, which are supplied as standard.

The Braking Module has as standard, the following interfaces:

- The DC link is connected through flexible cables
- Connecting terminal for external braking resistor
- 1 digital input (inhibit Braking Module with high signal/acknowledge error with negative edge high low)
- 1 digital output (Braking Module defective)
- DIP switch for adjusting the starting threshold

6.2.1.2 Safety instructions for Braking Modules chassis format



 WARNING
Electric shock due to the residual charge of the DC link capacitors Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury. <ul style="list-style-type: none">• Only carry out work on these components after this time has elapsed.• Measure the voltage before starting work on the DCP and DCN DC-link terminals.

 WARNING
Fire and device damage as a result of ground fault/short-circuit The cables to the braking resistor must be routed so that a ground fault or short circuit can be ruled out. A ground fault can result in fire with associated smoke. <ul style="list-style-type: none">• Comply with local installation regulations, which allow this fault to be ruled out.• Protect the cables from mechanical damage.• In addition, apply one of the following measures:<ul style="list-style-type: none">– Use cables with double insulation.– Observe adequate clearances, e.g. through the use of spacers.– Route the cables in separate cable ducts or pipes.

NOTICE
Damage to braking resistors that are not permissible An impermissible braking resistor may become damaged. <ul style="list-style-type: none">• Only use braking resistors that SIEMENS has authorized for SINAMICS.

6.2.1.3 Braking Module for frame size FX

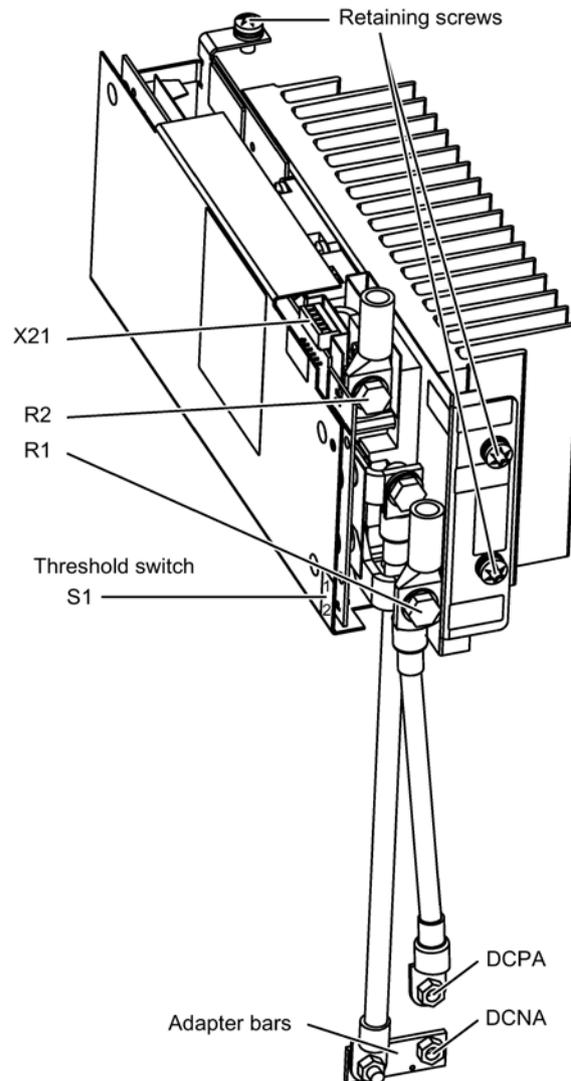


Figure 6-4 Braking Module for Power Module, frame size FX

Note

With this Braking Module, the R1 and DCPA interfaces use the same connection.

6.2.1.4 Braking Module for frame size GX

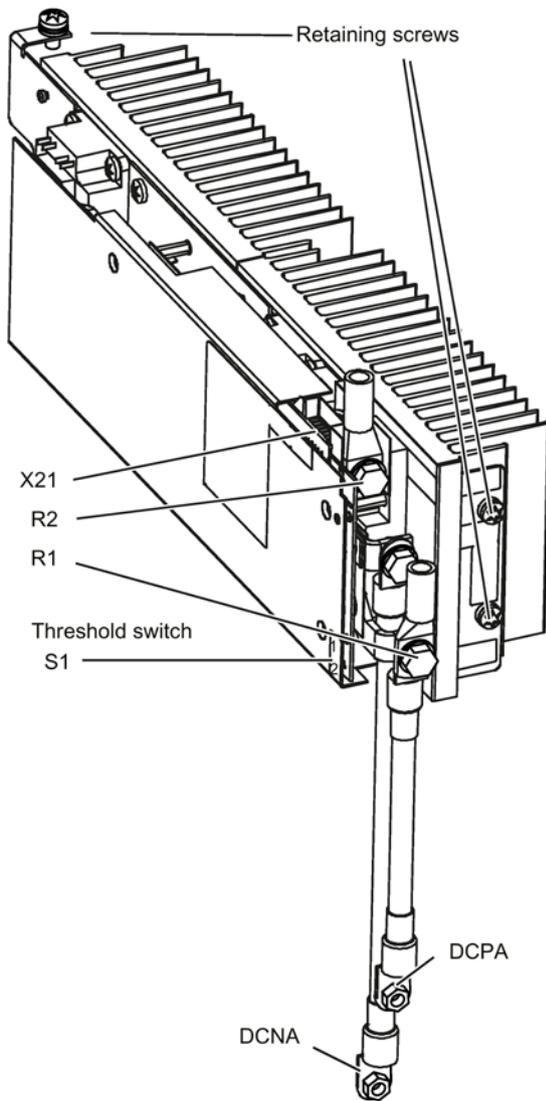


Figure 6-5 Braking Module for Power Module, frame size GX

Note

With this Braking Module, the R1 and DCPA interfaces use the same connection.

6.2.1.5 Connection example

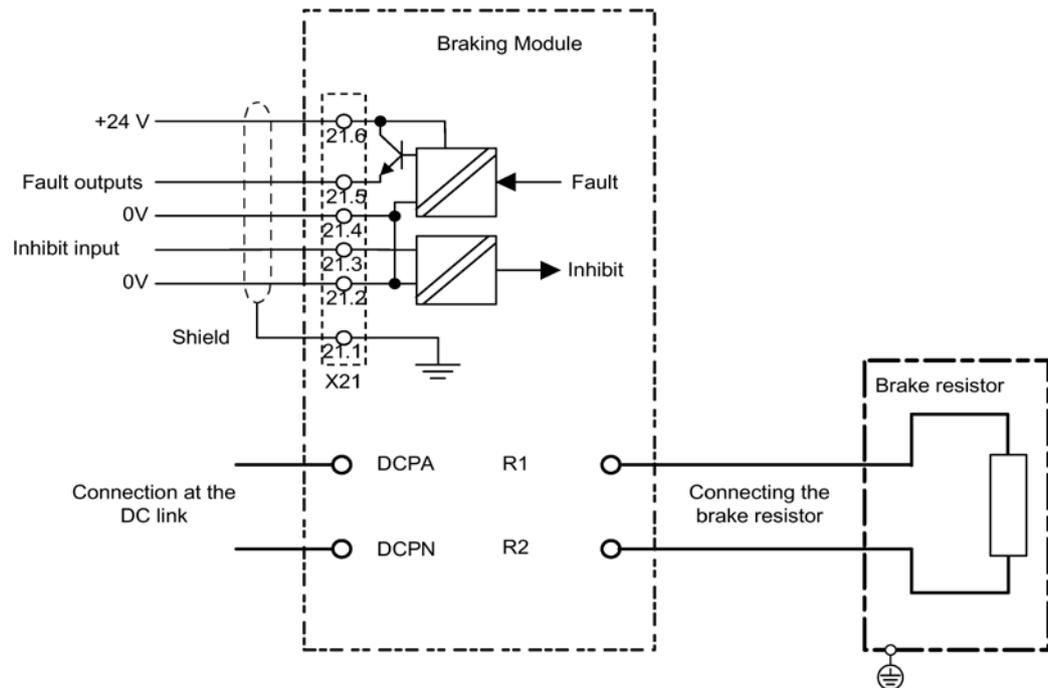


Figure 6-6 Example connection of Braking Module

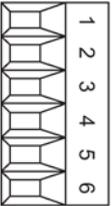
6.2.1.6 Braking resistor connection X1

Table 6-9 Braking resistor connection

Terminal	Designation
R1	Braking resistor connection R+
R2	Braking resistor connection R-
Max. connectable cross-section: 50 mm ² (AWG 1)	

6.2.1.7 X21 digital inputs/outputs

Table 6- 10 Terminal block X21

	Terminal	Designation ¹⁾	Technical data
	1	Shield	Shield connection for terminal 2 ... 6
	2	0 V	Low level: -3 ... 5 V
	3	DI inhibit input	High signal level: 15 ... 30 V Current consumption: 2 ... 15 mA
	4	0 V	Voltage: 24 V DC Load current: 0.5 ... 0.6 A
	5	DO fault output	
	6	+24 V	Voltage: 18 ... 30 V Typical current consumption (own current consumption): 10 mA at 24 V DC

Max. connectable cross-section: 1.5 mm² (AWG 16)

¹⁾ DI: Digital input; DO: Digital output

Note

When the Braking Module is in the installed state, the individual terminals on its X21 terminal block are positioned as follows: Terminal "1" is at the rear, terminal "6" at the front.

Note

Applying a high signal to terminal X21.3 inhibits the Braking Module. On a falling edge, pending error signals are acknowledged.

6.2.1.8 S1 Threshold switch

The response threshold at which the Braking Module is activated and the DC-link voltage generated during braking are specified in the following table.



WARNING

Electric shock when operating the threshold switch

Operating the threshold switch when a voltage is present can cause death or serious injury.

- Only operate the threshold switch when the Power Module is switched off and the DC link capacitors are discharged.

Table 6- 11 Response thresholds of the Braking Modules

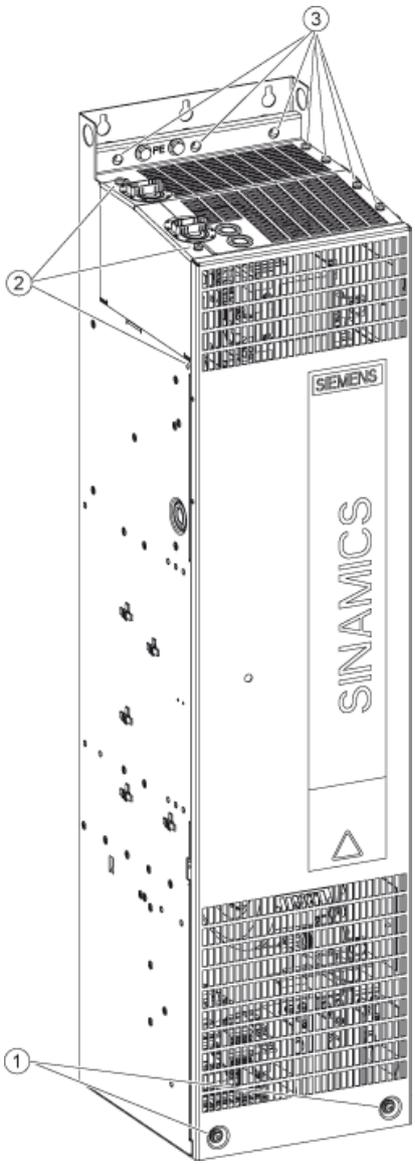
Response threshold	Switch position	Comment
673 V	1	774 V is the default factory setting. For line supply voltages of between 3-ph. 380 V and 400 V AC, the response threshold can be set to 673 V to reduce the voltage stress on the motor and Power Module. This does, however, reduce the possible braking power with the square of the voltage $(673/774)^2 = 0.75$. The maximum possible braking power is, therefore, 75%.
774 V	2	

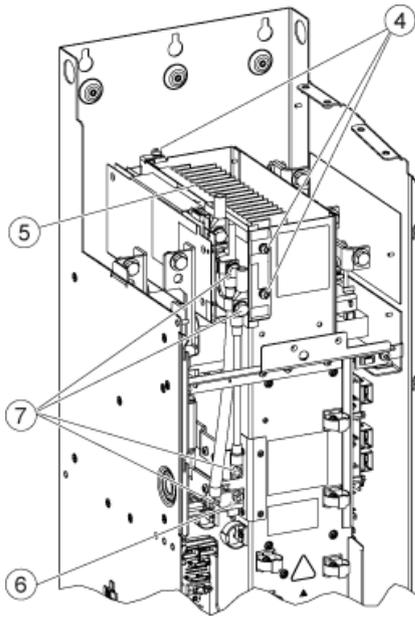
Note

The threshold switches of the Braking Modules are in the following positions when installed:

- Position "1" is up
- Position "2" is down

6.2.1.9 Installing a Braking Module in a Power Module, frame size FX

	<p>① Loosen the two M6 screws. Remove the front cover to the top.</p>
	<p>② Loosen the two screws from the cover plate at the top and the M6 nut on the left-hand side. Remove the cover plate at the left.</p>
	<p>③ Loosen the four screws from the cover plate at the top and the three securing screws at the rear. Remove the cover plate at the top.</p>

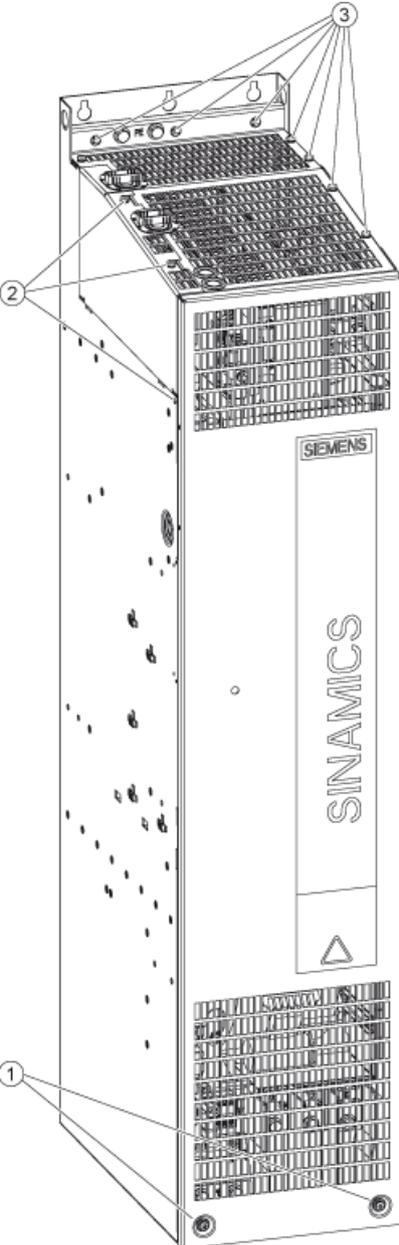
	④	Remove the three screws on the blanking cover. Remove the blanking cover.
	⑤	Install the Braking Module instead of the blanking cover and secure it with the blanking cover screws that were previously removed.
	⑥	Secure the adapter bars at the DCNA connection using a nut, so that the bar cannot be twisted. For this purpose, a small bolt is attached to the adapter bar, which must be located on the lower side of the DCNA connection.
	⑦	Secure the connecting cable to the DC link with two screws (Braking Module connection) and with two nuts (DC-link connection). Attach the <ul style="list-style-type: none"> - cover plate, top - step ③ - cover plate, left - step ② - the front cover - step ①

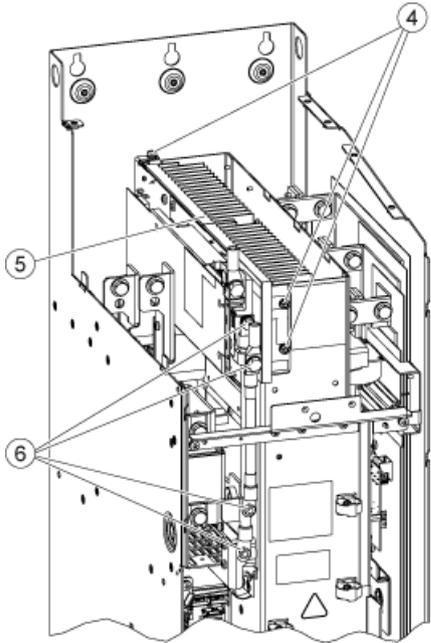
An opening above the connections for the braking resistor (R1, R2) is provided in the cover for connecting the cable to the braking resistor.

Note

You must carefully observe the specified tightening torques.

6.2.1.10 Installing a Braking Module in a Power Module, frame size GX

 <p>The diagram shows a vertical Siemens SINAMICS power module chassis. Callout 1 points to the bottom front corner. Callout 2 points to the top left side of the front cover. Callout 3 points to the top edge of the front cover.</p>	<p>① Loosen the two M6 screws. Remove the front cover to the top.</p>
	<p>② Loosen the two screws from the cover plate at the top and the M6 nut on the left-hand side. Remove the cover plate at the left.</p>
	<p>③ Loosen the four screws from the cover plate at the top and the three securing screws at the rear. Remove the cover plate at the top.</p>

	④	Remove the three screws on the blanking cover. Remove the blanking cover.
	⑤	Install the Braking Module instead of the blanking cover and secure it with the blanking cover screws that were previously removed.
	⑥	Secure the connecting cable to the DC link with two screws (Braking Module connection) and with two nuts (DC-link connection). Attach the - cover plate, top – step ③ - cover plate, left – step ② - the front cover – step ①

An opening above the connections for the braking resistor (R1, R2) is provided in the cover for connecting the cable to the braking resistor.

Note

You must carefully observe the specified tightening torques.

6.2.1.11 Technical data

Table 6- 12 Technical data, Braking Modules

Article number	6SL3300-1AE31-3AA0	6SL3300-1AE32-5AA0
Suitable for installation in Power Modules, frame size	FX	GX
P _{DB} power (unit rating)	25 kW	50 kW
P ₁₅ power (peak power)	125 kW	250 kW
P ₂₀ power	100 kW	200 kW
P ₄₀ power	50 kW	100 kW
Variable response thresholds	774 V (673 V)	774 V (673 V)
Digital input		
Rated voltage	-3 ... 30 V	-3 ... 30 V
Low signal level (an open digital input is interpreted as "low")	-3 ... 5 V	-3 ... 5 V
High level	15 ... 30 V	15 ... 30 V
Current drain (typical at 24 VDC)	10 mA	10 mA

Article number	6SL3300-1AE31-3AA0	6SL3300-1AE32-5AA0
Max. cross-section that can be connected	1.5 mm ² (AWG 16)	1.5 mm ² (AWG 16)
Digital output (continued-short-circuit-proof)		
Rated voltage	24 VDC	24 VDC
Max. load current of the digital output	500 mA	500 mA
Max. cross-section that can be connected	1.5 mm ² (AWG 16)	1.5 mm ² (AWG 16)
R1/R2 connection	M8 screw	M8 screw
Max. connection cross-section R1/R2	35 mm ² (AWG 2)	50 mm ² (AWG 1)
Weight	3.6 kg	7.3 kg

6.2.2 Braking resistors

6.2.2.1 Description

The braking resistor is used to reduce the excess DC link energy in regenerative operation.

The braking resistor is connected to the Braking Module. The braking resistor is mounted outside the cabinet or switchgear room. This means that the resulting heat loss around the Power Module can be dissipated - and cooling costs/equipment reduced.

Resistors with unit ratings of 25 kW and 50 kW are available.

Braking resistors can be used on Power Modules with a voltage range. This is the reason that the voltage can be changed by setting the response thresholds at the Braking Module to reduce the voltage stress on the motor and Power Module.

A temperature protection switch monitors the braking resistor for overtemperature and issues a signal on a floating contact if the limit value is exceeded.

6.2.2.2 Safety instructions for braking resistors chassis format

 **WARNING****Electric shock as a result of the connected voltage and residual charge of the DC link capacitors at the Braking Module**

Contact with live connections on the Braking Module can result in death or serious injury.

- Only connect the Braking Module when the Power Module is disconnected.
- Only connect the Braking Module after five minutes has elapsed. Measure the voltage before starting work on the DCP and DCN DC-link terminals.

 **WARNING****Fire through overheating due to insufficient ventilation clearances**

Insufficient ventilation clearances can result in overheating with danger to persons as a result of smoke and fire. This can also result in increased downtime and reduced service lives for devices/systems.

- It is essential that you maintain a cooling clearance of 200 mm on all sides of the component (with ventilation grills).

 **WARNING****Fire and device damage as a result of ground fault/short-circuit**

The cables to the braking resistor must be routed so that a ground fault or short circuit can be ruled out. A ground fault can result in fire with associated smoke.

- Comply with local installation regulations, which allow this fault to be ruled out.
- Protect the cables from mechanical damage.
- In addition, apply one of the following measures:
 - Use cables with double insulation.
 - Observe adequate clearances, e.g. through the use of spacers.
 - Route the cables in separate cable ducts or pipes.

 **CAUTION****Burns resulting from high surface temperature of the braking resistor**

The braking resistor can become very hot. You can be severely burnt when touching the surface.

- Mount the braking resistor so that it cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

 **WARNING**

Fire due to overheating resulting from excessively long connecting cables

Excessively long connection cables between the Braking Module and the external braking resistor may cause components to overheat with the associated risk of fire and smoke.

- The length of the connection cables between the Braking Module and the external braking resistor must not exceed 100 m.

 **WARNING**

Fire as a result of thermal power loss from the braking resistor

An incorrectly installed braking resistor can cause overheating of components with resulting fire and smoke.

- Only mount braking resistors on the floor.
- Mount the braking resistors so that they are in the vertical position and freestanding. Sufficient space must be available for dissipating the energy converted by the braking resistor.
- Maintain sufficient clearance to objects that can burn.
- Do not place any objects on or above the braking resistor.

NOTICE

Damage to braking resistor due to ingress of water

The ingress of water can damage the braking resistor.

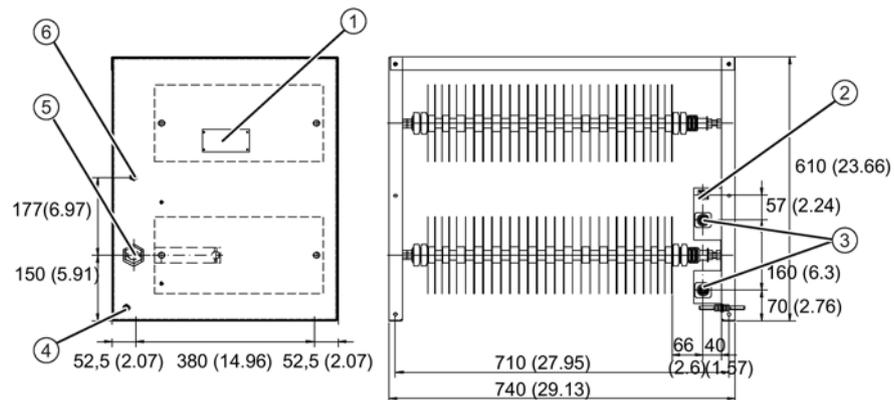
- To maintain degree of protection IP20, provide a canopy to protect against rain when mounting outside.

Note

Interaction between braking resistor and fire detection sensor

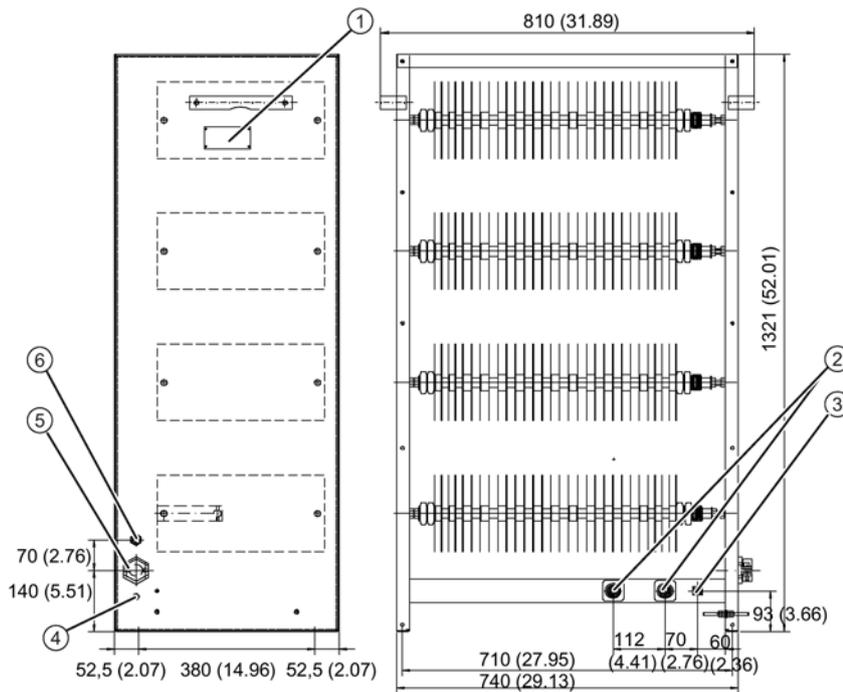
If a braking resistor is placed underneath a fire detection sensor, the heat generated could trigger the fire detection sensor.

6.2.2.3 Dimension drawing



- ① Rating plate
- ② T1/T2 screw terminal
- ③ Threaded bolt (M8)
- ④ Ground connection (M8)
- ⑤ M50
- ⑥ M12

Figure 6-7 Dimension drawing, 25 kW/125 kW resistor



- ① Rating plate
- ② Threaded bolt (M10)
- ③ T1/T2 screw terminal
- ④ Ground connection (M10)
- ⑤ M50
- ⑥ M12

Figure 6-8 Dimension drawing, 50 kW/250 kW resistor

6.2.2.4 Electrical connection

Recommended cable cross-sections:

- For 25 kW: 35 mm² (AWG 2)
- For 50 kW: 50 mm² (AWG 1)

Thermostatic switch

A thermostatic switch is installed to protect the braking resistor against overload. Its floating contacts must be integrated in the fault chain on the line side.

Table 6- 13 Thermostatic switch connection

Terminal	Function	Technical data
T1	Thermostatic switch connection	Voltage: 240 V AC Load current: Max. 10 A
T2	Thermostatic switch connection	

Max. connectable cross-section: 2.5 mm² (AWG 14)

6.2.2.5 Technical data

Table 6- 14 What is the technical data of the braking resistors

Article number	Unit	6SL3000-1BE31-3AA0	6SL3000-1BE32-5AA0
P _{DB} power (unit rating)	kW	25	50
P ₁₅ power (peak power)	kW	125	250
Max. current	A	189	378
Cable entry		Via cable gland M50	Via cable gland M50
Line connection		Via stud M10	Via stud M10
Max. cross-section that can be connected		50 mm ² (AWG 1)	70 mm ² (AWG 2/0)
Degree of protection		IP20	IP20
Width x height x depth	mm	740 x 605 x 485	740 x 1325 x 485 ¹⁾
Thermostatic switch (NC contact) maximum contact load connecting cable		240 VAC / 10 A	240 VAC / 10 A
Weight	kg	50	120

1) Dimensions including the mounting handles: 810 x 1325 x 485

Duty cycle

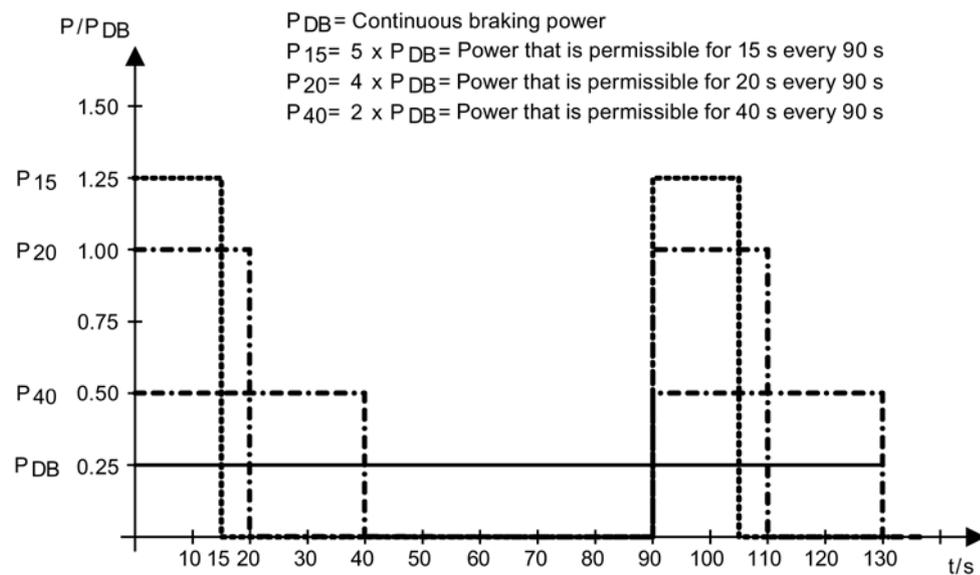


Figure 6-9 Duty cycle for braking resistors

Motor-side power components

7.1 Blocksize

7.1.1 Motor reactors

7.1.1.1 Description

Motor reactors reduce capacitive discharge currents which means that longer motor cables may be used.

At the same time, the stress on the motor windings caused by rates of voltage rise (dv/dt) is also diminished.

Preconditions

- Maximum ambient temperature: 40 °C
- Maximum pulse frequency: 4 kHz
- Maximum output frequency: 150 Hz
- Maximum current limit: 2 x rated current
- Operating modes: Vector control and U/f control

Note

Longer motor cables by using sine-wave filters or dv/dt filters

Longer motor cables for Power Modules FSD to FSG can be used when using sine-wave filters, dv/dt filters or dv/dt filters compact.

You can source suitable filters through our Solution Partners

(<https://www.automation.siemens.com/solutionpartner/partnerfinder/Home/Index?country=D&program=1&technology=19&lang=en>).

7.1.1.2 Safety instructions for motor reactors



 WARNING
Fire through overheating due to insufficient ventilation clearances Insufficient ventilation clearances can result in overheating with danger to persons as a result of smoke and fire. This can also result in increased downtime and reduced service lives for devices/systems. <ul style="list-style-type: none">• It is essential that you maintain 100 mm ventilation clearances above and below the component.

 CAUTION
Burns resulting from high surface temperature of the motor reactor The motor reactors can become very hot. You can be severely burnt when touching the surface. <ul style="list-style-type: none">• Mount the motor reactors so that they cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

NOTICE
Damage to the motor reactors due to use of non-approved components If components are used that have not been approved, damage or malfunctions can occur in the devices or the system itself. There is a risk that the motor reactor will be thermally damaged. <ul style="list-style-type: none">• Use only motor reactors that have been approved for SINAMICS by Siemens.

NOTICE
Damage to the motor reactor if the maximum output frequency is exceeded The maximum permissible output frequency when motor reactors are used is 150 Hz. At a higher output frequency, the motor reactor may be damaged. <ul style="list-style-type: none">• Do not operate the motor reactors above the maximum permissible output frequency of 150 Hz.

NOTICE
Damage to the motor reactor if the maximum pulse frequency is exceeded The maximum permissible pulse frequency when using motor reactors is 4 kHz. At a higher pulse frequency, the motor reactor may be damaged. <ul style="list-style-type: none">• Do not operate the motor reactors on the Power Module above the maximum permissible pulse frequency of 4 kHz.

7.1.1.3 Dimension drawings

Motor reactors 6SL3202-0AE16-1CA0 and -0AE18-8CA0 for PM240-2, FSA or FSB

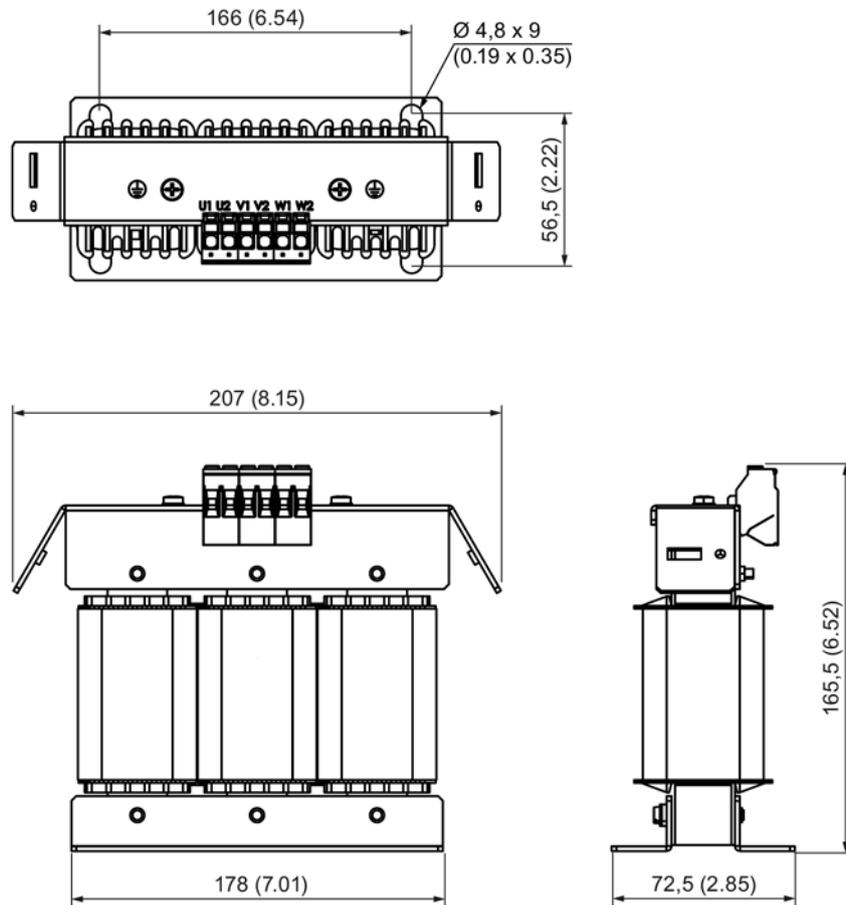


Figure 7-1 Dimension drawing, motor reactors 6SL3202-0AE16-1CA0 and 6SL3202-0AE18-8CA0, all data in mm and (inch)

7.1 Blocksize

Motor reactor 6SL3202-0AE21-8AC0 for PM240-2, FSB or FSC

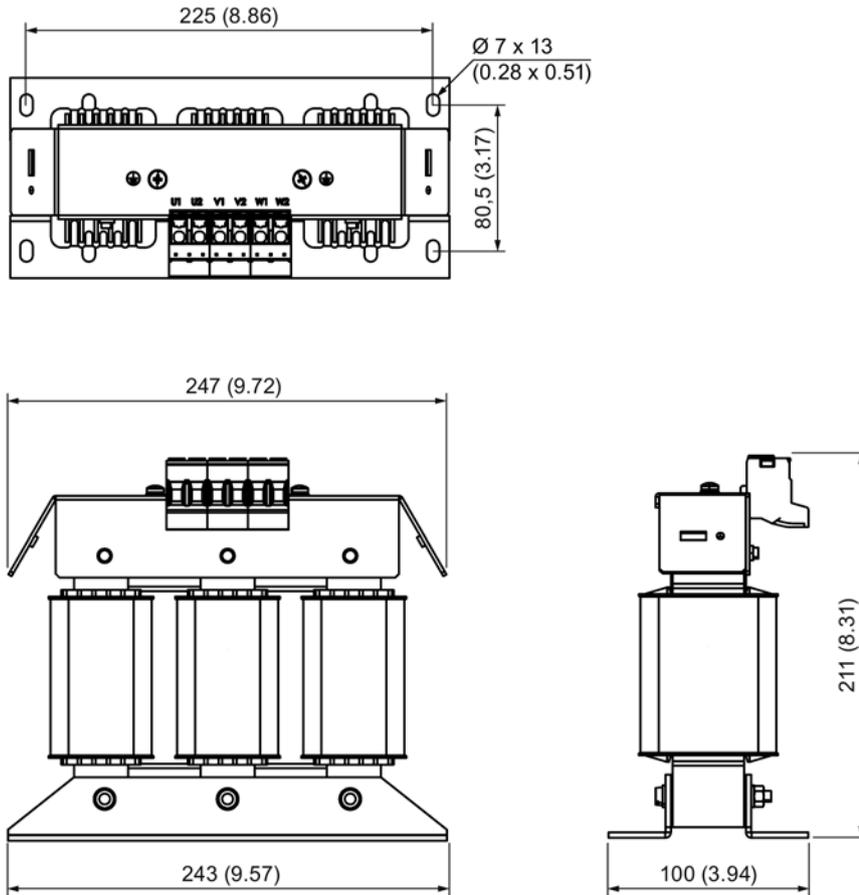


Figure 7-2 Dimension drawing, motor reactor 6SL3202-0AE21-8CA0, all data in mm and (inch)

Motor reactor 6SL3202-0AE23-8CA0 for PM240-2, FSC (400 V)

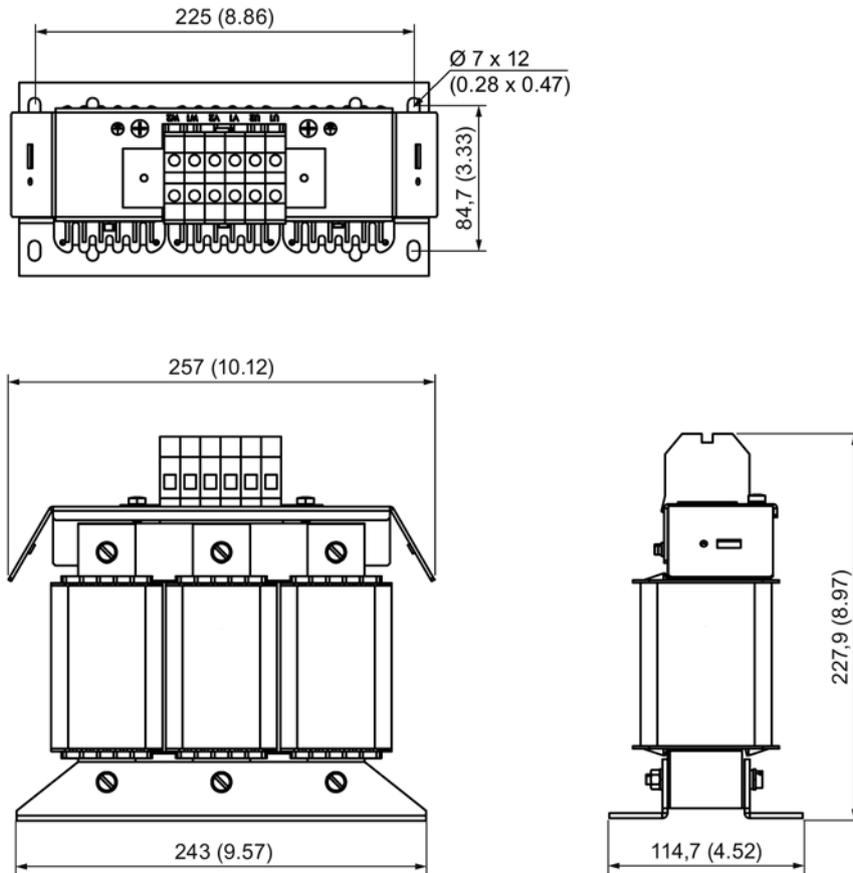


Figure 7-3 Dimension drawing, motor reactor 6SL3202-0AE23-8CA0, all data in mm and (inch)

6SE4000-3TC...D0 motor reactor for PM240-2, FSD-FSF (400 V)

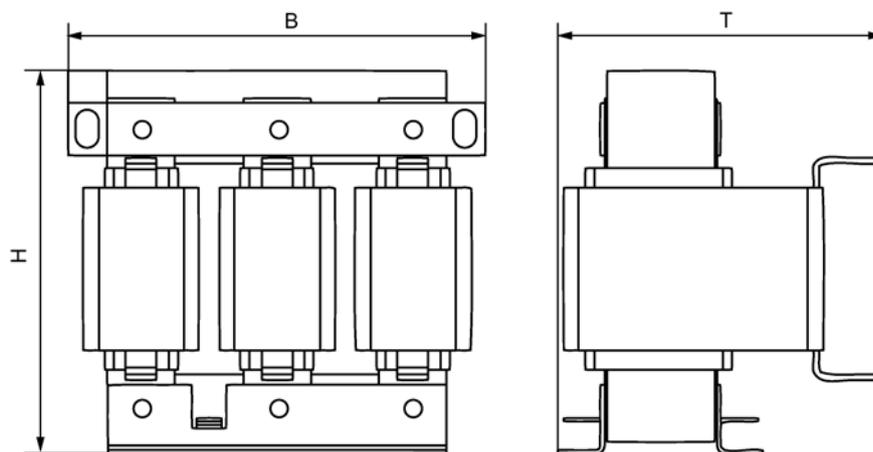


Figure 7-4 Dimension drawing of 6SE4000-3TC...D0 motor reactor, dimensions, see the following table

7.1 Blocksize

Table 7- 1 Dimensions of 6SE4000-3TC...D0 motor reactors, all measurements in mm and (inches)

6SE4000-	Frame size	B	H	T
3TC07-5ED0	FSD	270 (10.63)	248 (9.76)	209 (8.23)
3TC14-5FD0	FSE/FSF	350 (13.80)	321 (12.64)	288 (11.34)

6SL3000-2....-AA0 motor reactor for PM240-2, FSD-FSF (400 V / 690 V)

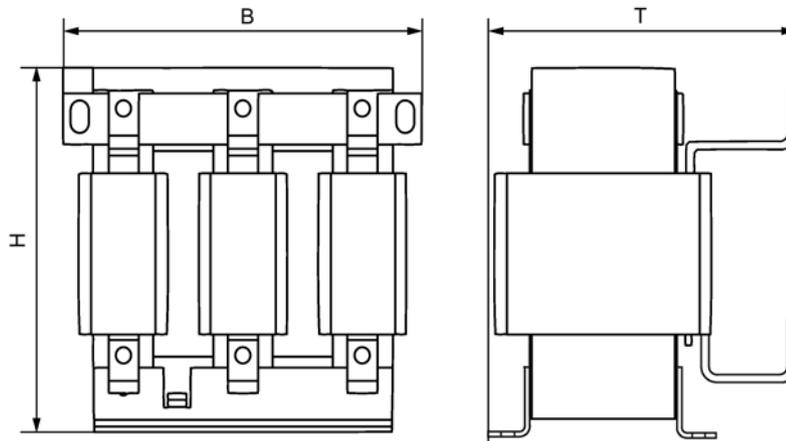


Figure 7-5 Dimension drawing of 6SL3000-2....-AA0 type 1 motor reactor, dimensions, see the following table

Table 7- 2 Dimensions of 6SL3000-2....-AA0 motor reactors, all dimensions in mm and (inches)

6SL3000-	Frame size	B	H	T
2BE32-1AA0	FSF (400 V)	300 (11.81)	285 (11.22)	257 (10.12)
2BE32-6AA0	FSF (400 V)	300 (11.81)	315 (12.40)	277 (10.91)
2BE33-2AA0	FSG (400 V)	300 (11.81)	285 (11.22)	257 (10.12)
2BE33-8AA0	FSG (400 V)	300 (11.81)	285 (11.22)	277 (10.91)
2AH31-0AA0	FSF (690 V)	270 (10.63)	231.7 (9.12)	203.7 (8.02)
2AH31-5AA0	FSF (690 V)	270 (10.63)	231.7 (9.12)	203.7 (8.02)
2AH31-8AA0	FSG (690 V)	300 (11.81)	285 (11.22)	212 (8.35)
2AH32-4AA0	FSG (690 V)	300 (11.81)	285 (11.22)	212 (8.35)
2AH32-6AA0	FSG (690 V)	300 (11.81)	285 (11.22)	212 (8.35)

6SL3000-2BE35-0AA0 motor reactor for PM240-2, FSG (400 V)

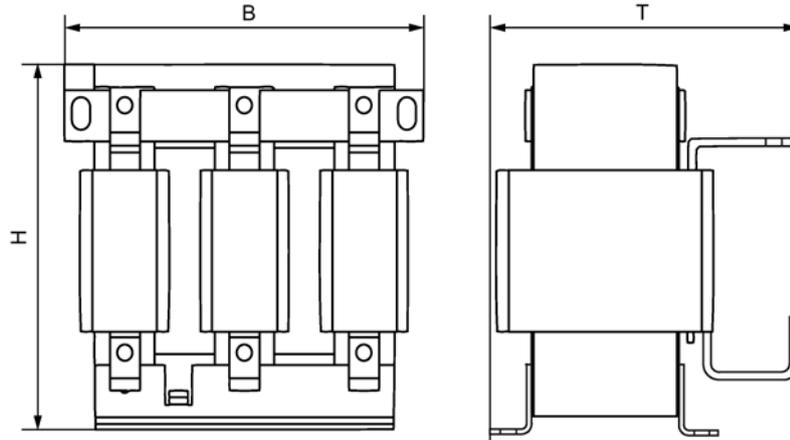


Figure 7-6 Dimension drawing of 6SL3000-2BE35-0AA0 type 2 motor reactor, dimensions, see the following table

Table 7- 3 Dimensions of 6SL3000-2BE35-0AA0 motor reactors, all dimensions in mm and (inches)

6SL3000-	FS	B	H	T
2BE35-0AA0	FSG (400 V)	300 (11.81)	365 (14.37)	277 (10.91)

7.1.1.4 Mounting

The motor reactors for PM240-2 Power Modules, frame sizes FSA to FSG, are designed for installation in cabinets. The motor reactor is installed on the mounting surface next to the Power Module.

Table 7- 4 Mounting of motor reactors for PM240-2 Power Modules

Article number	Fastening	Tightening torque
6SL3202-0A16-1CA0 6SL3202-0AE18-8CA0	4 x M4 screws 4 x M4 nuts 4 x M4 washers	3 Nm (26.6 lbf in)
6SL3202-0AE21-8CA0 6SL3202-0AE23-8CA0	4 x M5 screws 4 x M5 nuts 4 x M5 washers	5 Nm (44.2 lbf in)
6SE6400-3TC07-5ED0 6SE6400-3TC14-5FD0 6SL3000-2BE32-1AA0 6SL3000-2BE32-6AA0 6SL3000-2BE33-2AA0 6SL3000-2BE33-8AA0 6SL3000-2BE35-0AA0 6SL3000-2AH31-0AA0 6SL3000-2AH31-5AA0 6SL3000-2AH31-8AA0 6SL3000-2AH32-4AA0 6SL3000-2AH32-6AA0	4 x M8 screws 4 x M8 nuts 4 x M8 washers	25 Nm (221 lbf in)

7.1 Blocksize

7.1.1.5 Electrical connection

Note

Approved cables for UL applications

Use only 75° C copper cables.

Table 7- 5 Securing the connection cables to the motor reactor

Article number	Connection to the Power Module/motor connection		Protective conductor connection	
	Fastening	Tightening torque	Fastening	Tightening torque
6SL3202-0AE16-1CA0 6SL3202-0AE18-8CA0	Screw terminals 4 mm ² (AWG 12)	0.6 ... 0.8 Nm (5.3 ... 7.1 lbf in)	M4 studs	3 Nm (26.6 lbf in)
6SL3202-0AE21-8CA0	Screw terminals 10 mm ² (AWG 8)	1.5 ... 1.8 Nm (13.3 ... 15.9 lbf in)	M5 studs	5 Nm (44.3 lbf in)
6SL3202-0AE23-8CA0	Screw terminals 16 mm ² (AWG 6)	2.0 ... 4.0 Nm (17.7 ... 35.4 lbf in)	M5 studs	5 Nm (44.3 lbf in)
6SE6400-3TC07-5ED0	Flat connector for M6 cable lug	6 Nm (53.1 lbf in)	M6 screw	10 Nm (88.5 lbf in)
6SE6400-3TC14-5FD0	Flat connector for M8 cable lug	13 Nm (115 lbf in)	M8 screw	25 Nm (221 lbf in)
6SL3000-2BE32-1AA0 6SL3000-2BE32-6AA0 6SL3000-2BE33-2AA0 6SL3000-2BE33-8AA0	Flat connector for M10 cable lug	25 Nm (221 lbf in)	M8 screw	25 Nm (221 lbf in)
6SL3000-2BE35-0AA0	Flat connector for M12 cable lug	50 Nm (443 lbf in)	M8 screw	25 Nm (221 lbf in)
6SL3000-2AH31-0AA0 6SL3000-2AH31-5AA0 6SL3000-2AH31-8AA0 6SL3000-2AH32-4AA0 6SL3000-2AH32-6AA0	Flat connector for M10 cable lug	25 Nm (221 lbf in)	M6 screw	10 Nm (88.5 lbf in)

7.1.1.6 Technical data

Table 7- 6 Motor reactors for Power Modules PM240-2, part 1

Article No. 6SL3202-		0AE16-1CA0	0AE18-8CA0	0AE21-8CA0	0AE23-8CA0
Inductance	mH	2.5	1.3	0.54	0.26
Rated current	A	6.1	9.0	18.5	39.0
Power loss	kW	0.09	0.08	0.08	0.11
Degree of protection		IP20	IP20	IP20	IP20
Weight	kg	3.4	3.9	10.1	11.2

Article No. 6SL3202-		0AE16-1CA0	0AE18-8CA0	0AE21-8CA0	0AE23-8CA0
Matching Power Modules ¹⁾		Line voltage 1/3-phase 200 V AC -10 % to 240 V AC +10 %:			
		6SL3210- 1PB13-0□L0 1PB13-8□L0 1PB15-5□L0 6SL3211- 1PB13-8□L0	6SL3210- 1PB17-4□L0	6SL3210- 1PB21-0□L0 1PB21-4□L0 1PB21-8□L0 6SL3211- 1PB21-0□L0 1PB21-8□L0	-
		Line voltage 3 AC 380 V -10 % to 480 V +10 %:			
	6SL3210- 1PE11-8□L1 1PE12-3□L1 1PE13-2□L1 1PE14-3□L1 1PE16-1□L1	6SL3210- 1PE18-0□L1 6SL3211- 1PE18-0□L1	6SL3210- 1PE21-1□L0 1PE21-4□L0 1PE21-8□L0 6SL3211- 1PE21-8□L0	6SL3210- 1PE22-7□L0 1PE23-3□L0 6SL3211- 1PE23-3□L0	
Frame size		FSA/FSB	FSA/FSB	FSB/FSC	FSC
Type rating of the Power Module	kW	0.55 ... 2.2	1.5 ... 3	2.2 ... 7.5	11 ... 18.5

¹⁾ □ = A: Power Module with integrated line filter, □ = U: Power Module without integrated line filter

Table 7- 7 Motor reactors for Power Modules PM240-2, part 2

Article No. 6SE6400-		3TC07-5ED0	3TC14-5FD0
Inductance	mH	0.30	0.20
Rated current	A	90	178
Power loss	kW	0.27	0.47
Degree of protection		IP00	IP00
Weight	kg	27	57
Matching Power Modules ¹⁾		Line voltage 3 AC 380 V -10 % to 480 V +10 %:	
		6SL3210- 1PE23-8□L0 1PE24-5□L0 1PE26-0□L0 1PE27-5□L0 6SL3211- 1PE27-5□L0	6SL3210- 1PE28-8□L0 1PE31-1□L0 1PE31-5□L0 1PE31-8□L0 6SL3211- 1PE31-1□L0
Frame size		FSD	FSE/FSF
Type rating of the Power Module	kW	18.5 ... 37	45 ... 90

¹⁾ □ = A: Power Module with integrated line filter, □ = U: Power Module without integrated line filter

7.1 Blocksize

Table 7- 8 Motor reactors for Power Modules PM240-2, part 3

Article number 6SL3000-		2BE32-1AA0	2BE32-6AA0	2AH31-0AA0	2AH31-5AA0
Inductance	mH	0.053	0.04	0.16	0.11
Rated current	A	210	260	100	150
Power loss	kW	0.49	0.50	0.26 / 0.30	0.32 / 0.34
Degree of protection		IP00	IP00	IP00	IP00
Weight	kg	60	66	25	25.8
Matching Power Modules ¹⁾		Line voltage 3 AC 380 V -10 % to 480 V +10 %:			
		6SL3210-1PE32-1□L0	6SL3210-1PE32-5□L0 6SL3211-1PE32-5□L0	-	-
		Line voltage 3 AC 500 V -10 % to 690 V +10 %:			
		-	-	6SL3210-1PH28-0□L0 1PH31-0□L0	6SL3210-1PH31-2□L0 1PH31-4□L0
Frame size		FSF	FSF	FSF	FSF
Type rating of the Power Module	kW	110	132	75 / 90	110 / 132

1) □ = A: Power Module with integrated line filter, □ = U: Power Module without integrated line filter

Table 7- 9 Motor reactors for PM240-2 Power Modules, part 4

Article number 6SL3000-		2BE33-2AA0	2BE33-8AA0	2BE35-0AA0
Inductance	mH	0.032	0.027	0.020
Rated current	A	310	380	490
Power loss	kW	0.47	0.50	0.50
Degree of protection		IP00	IP00	IP00
Weight	kg	60	73	100
Suitable for Power Modules		Line voltage 3 AC 380 V -10 % to 480 V +10 %:		
		6SL3210-1PE33-0AL0	6SL3210-1PE33-7AL0	6SL3210-1PE34-8AL0
Frame size		FSG	FSG	FSG
Type rating of the Power Module	kW	160	200	250

Table 7- 10 Motor reactors for PM240-2 Power Modules, part 5

Article number 6SL3000-		2AH31-8AA0	2AH32-4AA0	2AH32-6AA0
Inductance	mH	0.092	0.080	0.067
Rated current	A	175	215	260
Power loss	kW	0.40	0.425	0.44
Degree of protection		IP00	IP00	IP00
Weight	kg	34	34	40

Article number 6SL3000-		2AH31-8AA0	2AH32-4AA0	2AH32-6AA0
Suitable for Power Modules		Line voltage 3 AC 500 V -10 % to 690 V +10 %:		
		6SL3210-1PH31-7CLO	6SL3210-1PH32-1CLO	6SL3210-1PH32-5CLO
Frame size		FSG	FSG	FSG
Type rating of the Power Module	kW	160	200	250

7.2 Chassis

7.2.1 Motor reactors

7.2.1.1 Description

Motor reactors reduce discharge currents which means that longer motor cables may be used.

At the same time, the stress on the motor windings caused by rates of voltage rise (dv/dt) is also diminished.

Preconditions

- Maximum ambient temperature: 40 °C
- Maximum pulse frequency: 4 kHz
- Maximum output frequency: 120 Hz
- Maximum current limit: 2 x rated current
- Operating modes: Vector control and U/f control

Support in STARTER

- From Version 2.4 and higher: up to 1 motor reactor
- From Version 2.5 and higher: up to 3 motor reactors

7.2.1.2 Safety instructions for motor reactors



 WARNING
Fire through overheating due to insufficient ventilation clearances Insufficient ventilation clearances can result in overheating with danger to persons as a result of smoke and fire. This can also result in increased downtime and reduced service lives for devices/systems. <ul style="list-style-type: none">• It is essential that you maintain 100 mm ventilation clearances above and below the component.

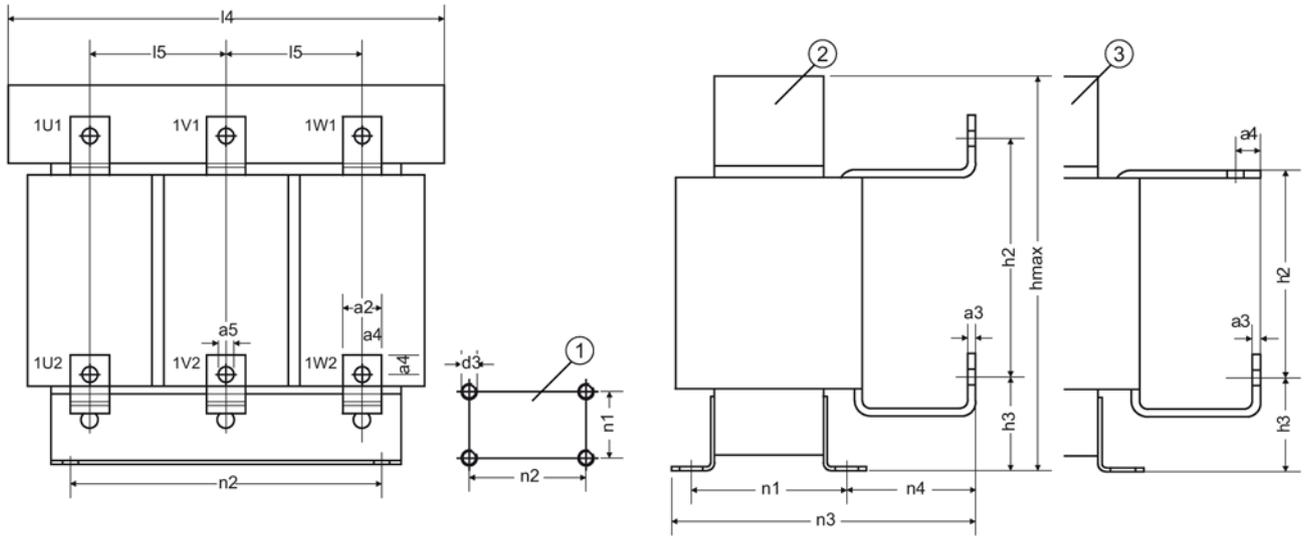
 CAUTION
Burns resulting from high surface temperature of the motor reactor The motor reactors can become very hot. You can be severely burnt when touching the surface. <ul style="list-style-type: none">• Mount the motor reactors so that they cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

NOTICE
Damage to the motor reactors due to use of non-approved components If components are used that have not been approved, damage or malfunctions can occur in the devices or the system itself. There is a risk that the motor reactor will be thermally damaged. <ul style="list-style-type: none">• Use only motor reactors that have been approved for SINAMICS by Siemens.

NOTICE
Damage to the motor reactor if the maximum output frequency is exceeded The maximum permissible output frequency when motor reactors are used is 150 Hz. At a higher output frequency, the motor reactor may be damaged. <ul style="list-style-type: none">• Do not operate the motor reactors above the maximum permissible output frequency of 150 Hz.

NOTICE
Damage to the motor reactor if the maximum pulse frequency is exceeded The maximum permissible pulse frequency when using motor reactors is 4 kHz. At a higher pulse frequency, the motor reactor may be damaged. <ul style="list-style-type: none">• Do not operate the motor reactors on the Power Module above the maximum permissible pulse frequency of 4 kHz.

7.2.1.3 Dimension drawing



- ① Mounting hole
- ② Motor reactor type 1
- ③ Motor reactor type 2

Figure 7-7 Dimension drawing, motor reactor

6SL3000-	2BE32-1AA0	2BE32-6AA0	2BE33-2AA0	2BE33-8AA0	2BE35-0AA0
Connection type	1	1	1	1	2
a2	25 (0.98)	25 (0.98)	25 (0.98)	25 (0.98)	30 (1.18)
a3	5 (0.19)	5 (0.19)	5 (0.19)	5 (0.19)	6 (0.23)
a4	12.5 (0.49)	12.5 (0.49)	12.5 (0.49)	12.5 (0.49)	15 (0.59)
a5	11 (0.43)	11 (0.43)	11 (0.43)	11 (0.43)	14 (0.55)
l4	300 (11.81)	300 (11.81)	300 (11.81)	300 (11.81)	300 (11.81)
l5	100 (3.93)	100 (3.93)	100 (3.93)	100 (3.93)	100 (3.93)
hmax	285 (11.22)	315 (12.40)	285 (11.22)	285 (11.22)	365 (14.37)
h2	194 (7.63)	227 (8.93)	194 (7.63)	194 (7.63)	245 (9.64)
h3	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)
n1 ¹⁾	163 (6.41)	183 (7.20)	163 (6.41)	183 (7.20)	183 (7.20)
n2 ¹⁾	224 (8.81)	224 (8.81)	224 (8.81)	224 (8.81)	224 (8.81)
n3	257 (10.11)	277 (10.90)	257 (10.11)	277 (10.90)	277 (10.90)
n4	79 (3.11)	79 (3.11)	79 (3.11)	79 (3.11)	79 (3.11)
d3	M8	M8	M8	M8	M8

¹⁾ Lengths n1 and n2 correspond to the distance between holes.

7.2.1.4 Technical data

Table 7- 11 Technical data, motor reactors

Article number	6SL3000-	2BE32-1AA0	2BE32-6AA0	2BE33-2AA0	2BE33-8AA0	2BE35-0AA0
Suitable for Power Module	6SL3310-	1TE32-1AA.	1TE32-6AA.	1TE33-1AA.	1TE33-8AA.	1TE35-0AA.
Unit rating of the Power Module	kW	110	132	160	200	250
Rated current	A	210	260	310	380	490
Power loss						
- at 50 Hz	kW	0.436	0.454	0.422	0.447	0.448
- at 150 Hz	kW	0.486	0.5	0.47	0.5	0.5
Connections						
- to the Motor Module (1U1, 1V1, 1W1)		M10	M10	M10	M10	M12
- to the load (1U2, 1V2, 1W2)		M10	M10	M10	M10	M12
- protective conductor		M8	M8	M8	M8	M8
Max. permissible cable length between motor reactor and motor		300 (shielded) / 450 (unshielded) 525 (shielded) / 787 (unshielded)				
- with 1 motor reactor	m					
- with 2 motor reactors in series	m					
Degree of protection		IP00	IP00	IP00	IP00	IP00
Dimensions						
Width	mm	300	300	300	300	300
Height	mm	285	315	285	285	365
Depth	mm	257	277	257	277	277
Weight	kg	60	66	60	73	100

7.2.2 Sinusoidal filter

7.2.2.1 Description

The sine-wave filter at the output of the Power Module supplies voltages that are virtually sinusoidal at the motor, thereby enabling standard motors to be used without shielded cables and without the need to reduce the power. Non-shielded cables can be used and, if long motor supply cables are used, no additional motor reactors are required.

Sine-wave filters with a power rating of up to 200 kW are available

The pulse frequency of the Power Modules must be set to 4 kHz for the sine-wave filters. This reduces the output current of the Power Module, see Chapter Overload capability (Page 157).

When a sine-wave filter is used, the available output voltage decreases by 15%.

7.2.2.2 Safety instructions for sine-wave filters


! WARNING
Electric shock in the event of missing touch protection

Touching live components can result in death or serious injury.

- For the sine-wave filters, use touch protection according to IPXXA or corresponding to the local installation regulations.

! WARNING
Fire through overheating due to insufficient ventilation clearances

Insufficient ventilation clearances result in overheating with danger to persons as a result of smoke and fire. This can also result in increased downtime and reduced service lives for devices/systems.

- It is essential that you maintain 100 mm ventilation clearances above and below the component.


! CAUTION
Burns resulting from high surface temperature of the sine-wave filter

The sine-wave filters can have surface temperatures of over 80° C. You can be severely burnt when touching the surface.

- Mount the sine-wave filter so that it cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

NOTICE
Sine-wave filter damage due to interchanged connections

Interchanging the input and output connections will damage the sine-wave filter.

- Connect the incoming cable from the Power Modules to 1U1, 1V1, 1W1.
- Connect the outgoing cable to the load at 1U2, 1V2, 1W2.

NOTICE
Damage to the Power Module by using components that have not been released

When using components that have not been released, damage or malfunctions can occur at the devices or the system itself.

- Only use sine-wave filters that SIEMENS has released for SINAMICS.

NOTICE

Risk of damaging sine-wave filter by exceeding the maximum output frequency

The maximum permissible output frequency when sine-wave filters are used is 150 Hz. The sine-wave filter can be damaged if the output frequency is exceeded.

- When commissioning, you must always activate the sine-wave filter connected to the Power Module (see SINAMICS S120/S150 List Manual).

NOTICE

Damage to the sine-wave filter if a motor is not connected

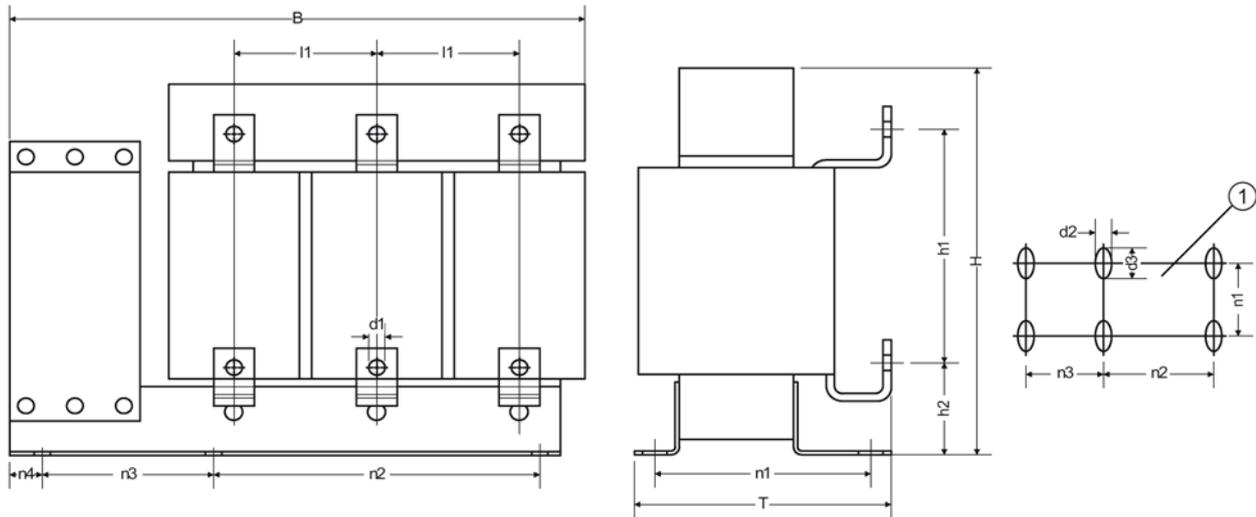
Sine-wave filters, which are operated without a motor being connected, can be damaged or destroyed.

- Never operate a sine-wave filter connected to the Power Module without a connected motor.

Note

Keep the connecting cables to the Power Module as short as possible (max. 5 m).

7.2.2.3 Dimension drawing



① Mounting hole

Figure 7-8 Dimension drawing, sine-wave filter

Table 7- 12 Dimensions, sine-wave filter in mm (inches)

6SL3000-	2CE32-3AA0	2CE32-8AA0	2CE33-3AA0	2CE34-1AA0
B	620 (24.40)	620 (24.40)	620 (24.40)	620 (24.40)
H	300 (11.81)	300 (11.81)	370 (14.56)	370 (14.56)
D	320 (12.59)	320 (12.59)	360 (14.17)	360 (14.17)
l1	140 (5.51)	140 (5.51)	140 (5.51)	140 (5.51)
h1	180 (7.08)	180 (7.08)	220 (8.66)	220 (8.66)
h2	65 (3.34)	65 (3.34)	65 (3.34)	65 (3.34)
n1 ¹⁾	280 (11.02)	280 (11.02)	320 (12.59)	320 (12.59)
n2 ¹⁾	150 (5.90)	150 (5.90)	150 (5.90)	150 (5.90)
n3 ¹⁾	225 (8.85)	225 (8.85)	225 (8.85)	225 (8.85)
n4	105 (4.13)	105 (4.13)	105 (4.13)	105 (4.13)
d1	12 (0.47)	12 (0.47)	12 (0.47)	12 (0.47)
d2	11 (0.43)	11 (0.43)	11 (0.43)	11 (0.43)
d3	22 (0.86)	22 (0.86)	22 (0.86)	22 (0.86)

¹⁾ Dimensions n1, n2, n3 correspond to the hole spacing.

7.2.2.4 Technical data

Table 7- 13 Technical data, sine-wave filter

Article number	6SL3000-	2CE32-3AA0	2CE32-3AA0	2CE32-8AA0	2CE33-3AA0	2CE34-1AA0
Suitable for Power Module	6SL3310-	1TE32-1AA.	1TE32-6AA.	1TE33-1AA.	1TE33-8AA.	1TE35-0AA.
Unit rating of the Power Module at a 4 kHz pulse frequency	kW	90	110	132	160	200
Rated current	A	225	225	276	333	408
Power loss - at 50 Hz - at 150 Hz	kW kW	0.35 0.6	0.35 0.6	0.4 0.69	0.245 0.53	0.38 0.7
Connections - to the Power Module - to the load - protective conductor		M10 connecting lugs M10 connecting lugs M10 drill hole				
Max. permissible cable length between sine-wave filter and motor	m	300 (shielded) 450 (unshielded)				
Degree of protection		IP00	IP00	IP00	IP00	IP00
Dimensions						
Width	mm	620	620	620	620	620
Height	mm	300	300	300	370	370
Depth	mm	320	320	320	360	360
Weight, approx.	kg	124	124	127	136	198

7.2.3 dv/dt filter plus Voltage Peak Limiter

7.2.3.1 Description

The dV/dt filter plus Voltage Peak Limiter consists of two components: the dV/dt reactor and the voltage limiting network (Voltage Peak Limiter), which limits voltage peaks and returns the energy to the DC link.

The dV/dt filters with Voltage Peak Limiter must be used for motors for which the proof voltage of the insulation system is unknown or insufficient. Standard motors of the 1LA5, 1LA6 and 1LA8 series only require them at supply voltages > 500 V +10 %.

dV/dt filters plus Voltage Peak Limiters limit the rate of voltage rise to values < 500 V/μs and the typical voltage peaks with rated line voltages to the values below (with motor cable lengths less than 150 m):

< 1000 V at $V_{line} < 575$ V.

Components

The article numbers of the individual components (dv/dt reactor and Voltage Peak Limiter) are listed in the following table:

Table 7- 14 du/dt filter plus Voltage Peak Limiter, article numbers of the individual components

dV/dt filter plus Voltage Peak Limiter	dV/dt reactor	Voltage peak limiter
6SL3000-2DE32-6AA0	6SL3000-2DE32-6CA0	6SL3000-2DE32-6BA0
6SL3000-2DE35-0AA0	6SL3000-2DE35-0CA0	6SL3000-2DE35-0BA0

7.2.3.2 Safety instructions for du/dt filter plus Voltage Peak Limiter

**! WARNING****Electric shock in the event of missing touch protection**

Touching live components can result in death or serious injury.

- For the dV/dt filters plus Voltage Peak Limiter, use touch protection according to IPXXA or corresponding to the local installation regulations.

! WARNING**Fire through overheating due to insufficient ventilation clearances**

Insufficient ventilation clearances can result in overheating with danger to persons as a result of smoke and fire. Furthermore, an increased number of failures and shorter service life of the components can occur.

- Maintain 100 mm ventilation clearances above and below the component.

**! CAUTION****Burns resulting from high surface temperature of the dv/dt reactor**

The surface temperature of the du/dt reactors may exceed 80 °C. You can be severely burnt when touching the surface.

- Mount the du/dt reactor so that it cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

NOTICE**Damage to the Voltage Peak Limiter due to interchanged connections**

The Voltage Peak Limiter will be damaged if the input and output connections are interchanged.

- Connect the incoming cable from the DC link of the Motor Module to DCPS, DCNS.
- Connect the outgoing cable for the du/dt reactor to 1U2, 1V2, 1W2.

NOTICE**Damage to the dV/dt filter by using components that have not been released**

When using components that have not been released, damage or malfunctions can occur at the devices or the system itself.

- Only use dV/dt filters that SIEMENS has approved for operation with SINAMICS.

NOTICE

Damage to the dV/dt filter by exceeding the maximum output frequency

The maximum permissible output frequency when using a du/dt filter is 150 Hz. The du/dt filter can be damaged if the output frequency is exceeded.

- Operate the du/dt filter with a maximum output frequency of 150 Hz.

NOTICE

Damage to the dV/dt filter by exceeding the maximum pulse frequency

The maximum permissible pulse frequency when using a du/dt filter is 4 kHz. The du/dt filter can be damaged if the pulse frequency is exceeded.

- When using the du/dt filter, operate the Motor Module with a maximum pulse frequency of 4 kHz.

NOTICE

Damage to the dv/dt filter if it is not activated during commissioning

The du/dt filter may be damaged if it is not activated during commissioning.

- Activate the du/dt filter during commissioning using parameter p0230 = 2.

NOTICE

Damage to the dV/dt filter if motor is not connected

du/dt filters which are operated without a motor being connected can be damaged or destroyed.

- Never operate a du/dt filter connected to the Motor Module without a connected motor.

Note

Cable lengths

Keep the connecting cables to the Motor Module as short as possible (max. 5 m).

7.2.3.3 Interface description

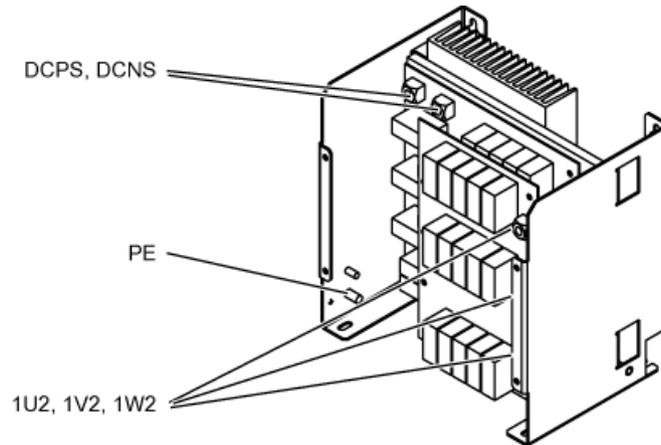


Figure 7-9 Interface overview, Voltage Peak Limiter, type 1

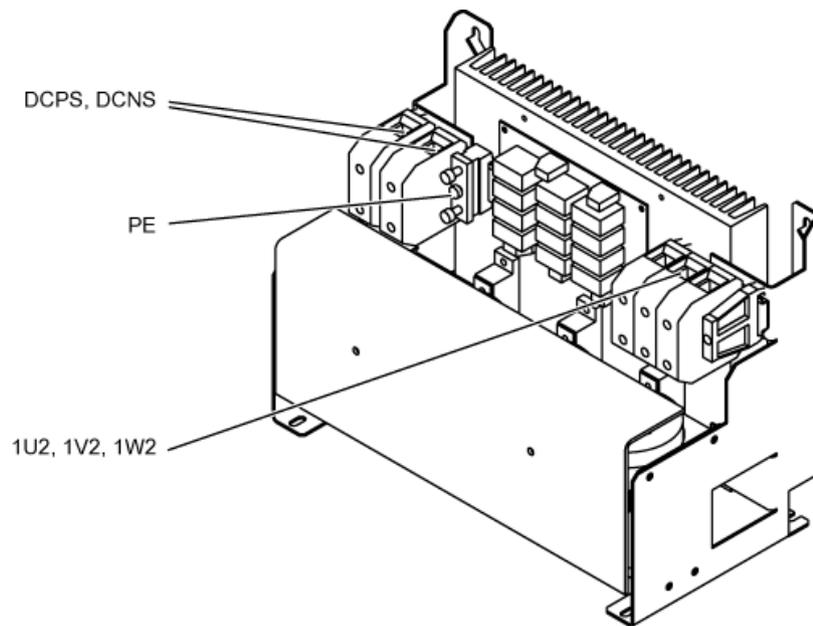


Figure 7-10 Interface overview, Voltage Peak Limiter, type 2

7.2.3.4 Connecting the dv/dt filter plus Voltage Peak Limiter

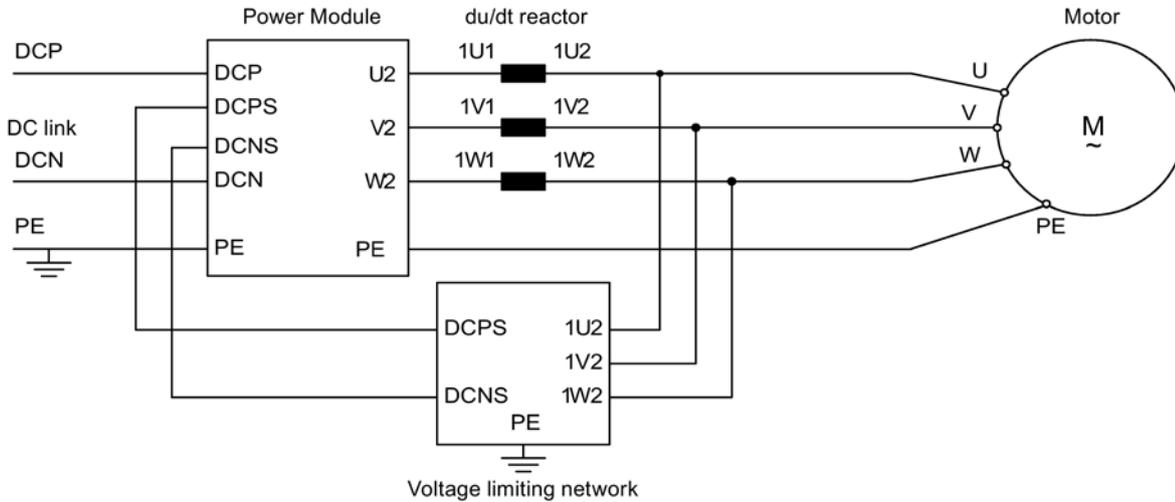


Figure 7-11 Connecting the dV/dt filter plus Voltage Peak Limiter

Cable cross-sections

Table 7- 15 Cable cross-sections for connections between a dV/dt filter and Power Module

dV/dt filter plus Voltage Peak Limiter	Connection to the DC link (DCPS / DCNS) [mm²]	Connection between a dV/dt reactor and Voltage Peak Limiter (1U2, 1V2, 1W2) [mm²]
6SL3000-2DE32-6AA0	35 (AWG 2)	10 (AWG 8)
6SL3000-2DE35-0AA0	70 (AWG 2/0)	16 (AWG 6)

⚠ WARNING

Fire and device damage as a result of ground fault/short-circuit

The connection to the DC link of the Power Module must be routed so that a ground fault or short-circuit can be ruled out. A ground fault can cause a fire with the associated smoke.

- Apply the local installation regulations to avoid this fault.
- Protect the cables against mechanical damage.
- Also implement one of the following measures:
 - Use cables with double insulation.
 - Maintain adequate clearance, e.g. by using spacers.
 - Lay the cables in separate cable ducts or conduits.

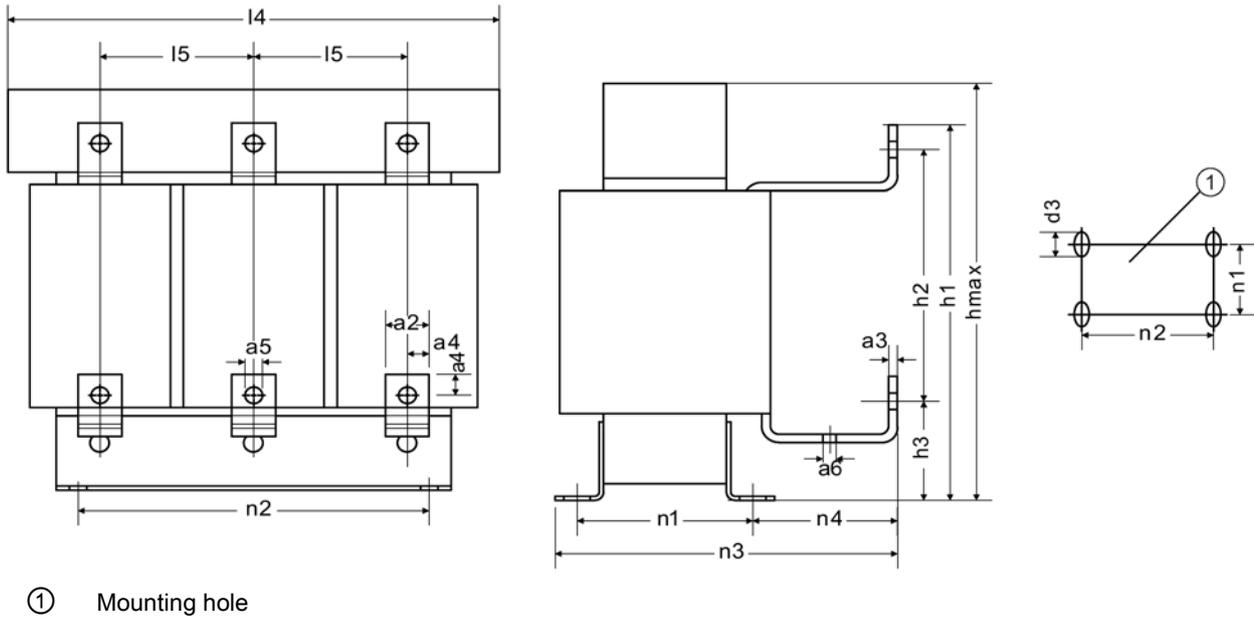
Note

Maximum cable length

The connections should be kept as short as possible.

The maximum cable length for the specified connections is 5 m in each case.

7.2.3.5 Dimension drawing, dv/dt reactor



① Mounting hole

Figure 7-12 Dimension drawing, dv/dt reactor

Table 7- 16 Dimensions dv/dt reactor, 3-phase 380 VAC - 480 VAC in mm (inch)

6SL3000-	2DE32-6CA0	2DE35-0CA0
a2	25 (0.98)	30 (1.18)
a3	5 (0.19)	6 (0.23)
a4	14 (0.55)	17 (0.66)
a5	10.5 x 14 (0.41 x 0.55)	14 x 18 (0.55 x 0.70)
a6	7 (0.27)	9 (0.35)
l4	410 (16.14)	460 (18.11)
l5	135 (5.31)	152.5 (6.00)
hmax	370 (14.56)	370 (14.56)
h2	258 (10.15)	240 (9.44)
h3	76 (2.99)	83 (3.26)
n1 ¹⁾	141 (5.55)	182 (7.16)
n2 ¹⁾	316 (12.44)	356 (14.01)
n3	229 (9.01)	275 (10.82)
n4	72 (2.83)	71 (2.79)
d3	M10 [12 x 18] (0.47 x 0.70)	M12 [15 x 22] (0.59 x 0.86)

¹⁾ Lengths n1 and n2 correspond to the distance between holes.

7.2.3.6 Dimension drawing of the voltage peak limiter

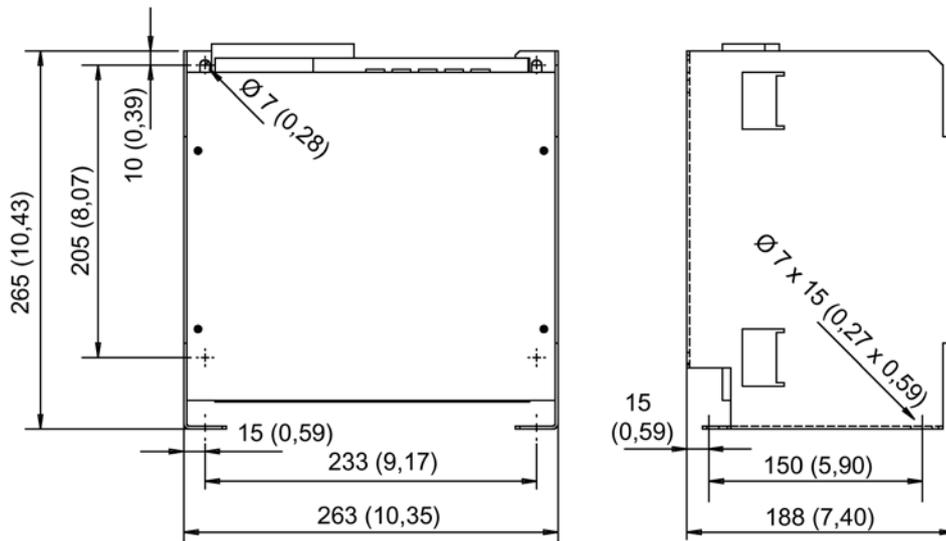


Figure 7-13 Dimension drawing of the Voltage Peak Limiter, type 1

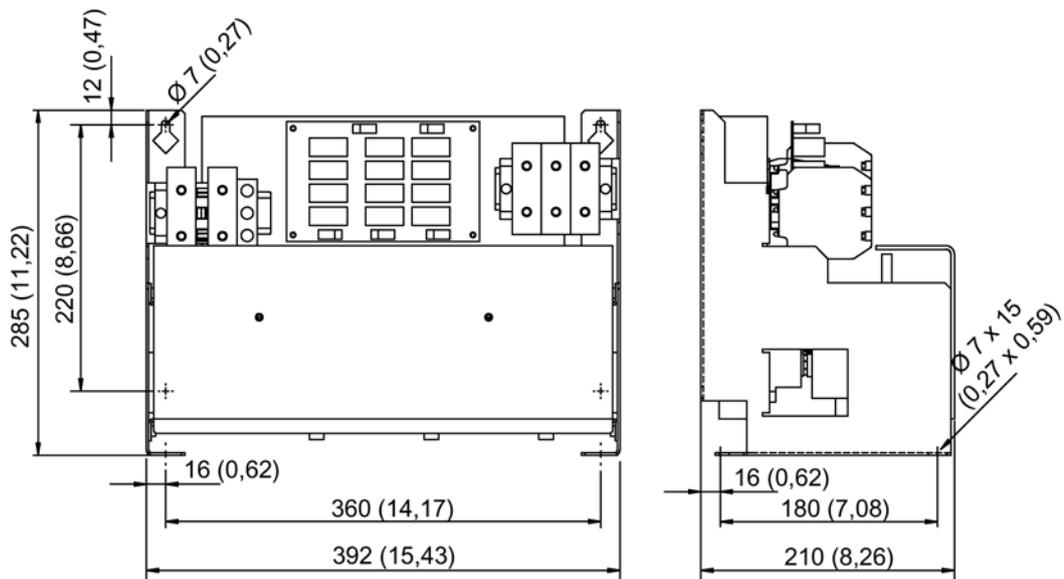


Figure 7-14 Dimension drawing of the Voltage Peak Limiter, type 2

Table 7- 17 Assigning Voltage Peak Limiter to dimension drawings

Voltage peak limiter	Dimension drawing type
6SL3000-2DE32-6BA0	Type 1
6SL3000-2DE35-0BA0	Type 2

7.2.3.7 Technical data

Table 7- 18 Technical data, dV/dt filter plus Voltage Peak Limiter

Article number	6SL3000-	2DE32-6AA0	2DE35-0AA0
Suitable for Power Module (unit rating)	6SL3310-	1TE32-1AA. (110 kW) 1TE32-6AA. (132 kW)	1TE33-1AA. (160 kW) 1TE33-8AA. (200 kW) 1TE35-0AA. (250 kW)
I_{thmax}	A	260	490
Degree of protection		IP00	IP00
dV/dt reactor			
Power loss			
- at 50 Hz	kW	0.701	0.874
- at 60 Hz	kW	0.729	0.904
- at 150 Hz	kW	0.78	0.963
Connections			
- to the Power Module		M10	M12
- load		M10	M12
- protective conductor		M6	M6
Max. permissible cable length between dV/dt reactor and motor	m	300 (shielded) 450 (unshielded)	
Dimensions			
Width	mm	410	460
Height	mm	370	370
Depth	mm	229	275
Weight, approx.	kg	66	122
Voltage Peak Limiter			
Power loss			
- at 50 Hz	kW	0.029	0.042
- at 60 Hz	kW	0.027	0.039
- at 150 Hz	kW	0.025	0.036
Connections			
- to the dV/dt reactor		M8	Terminal 70 mm ²
- DC		M8	Terminal 70 mm ²
- protective conductor		M8	Terminal 35 mm ²
Dimensions			
Width	mm	265	392
Height	mm	263	285
Depth	mm	190	210
Weight, approx.	kg	6	16

7.2.4 dv/dt filter compact plus Voltage Peak Limiter

7.2.4.1 Description

The dV/dt filter compact plus Voltage Peak Limiter has two components: The dV/dt reactor and the voltage limiting network (Voltage Peak Limiter). The voltage limiting network cuts-off the voltage peaks and feeds the energy back into the DC link.

The dV/dt filter compact plus Voltage Peak Limiter is designed for use with motors for which the voltage strength of the insulation system is unknown or insufficient.

The dV/dt filters compact plus Voltage Peak Limiter limit the voltage load on the motor cables to values which correspond to limit value curve A according to IEC/TS 60034-25:2007.

The rate of voltage rise is limited to $< 1,600 \text{ V}/\mu\text{s}$, the peak voltages are limited to $< 1400 \text{ V}$.

7.2.4.2 Safety instructions for du/dt filter compact plus Voltage Peak Limiter


! WARNING
Electric shock in the event of missing touch protection

Touching live components can result in death or serious injury.

- For the dv/dt filters compact plus Voltage Peak Limiter, use touch protection according to IPXXA or corresponding to the local installation regulations.

! WARNING
Fire through overheating due to insufficient ventilation clearances

Insufficient ventilation clearances can result in overheating with danger to persons as a result of smoke and fire. Furthermore, an increased number of failures and shorter service life of the components can occur.

- Maintain 100 mm ventilation clearances above and below the component.
- Always mount the dv/dt filters compact plus Voltage Peak Limiter in a vertical, upright position, to enable cooling air to flow through the heat sink on the Voltage Peak Limiter from the bottom to the top.


! CAUTION
Burns due to high surface temperature of the dv/dt filter compact

The surface temperature of the dv/dt filters compact may exceed 80 °C. You can be severely burnt when touching the surface.

- Mount the dv/dt filters compact so that they cannot be touched. If this is not possible, at the dangerous locations, attach an appropriate warning note that is clearly visible and easy to understand.

NOTICE
Damage to the dv/dt filter compact by using components that have not been released

When using components that have not been released, damage or malfunctions can occur at the devices or the system itself.

- Only use a dv/dt filter compact that SIEMENS has released for SINAMICS.

NOTICE
Damage to the dv/dt filter compact by exceeding the maximum output frequency

The maximum permissible output frequency when a dv/dt filter compact is used is 150 Hz. The dv/dt filter compact can be damaged if the output frequency is exceeded.

- Operate the dv/dt filter compact with a maximum output frequency of 150 Hz.

NOTICE

Damage to the dv/dt filter compact during continuous operation with low output frequencies

Uninterrupted duty at an output frequency less than 10 Hz can result in thermal overload and destroy the dv/dt filter.

- When using a dv/dt filter compact plus voltage peak limiter do not operate the drive continuously with an output frequency less than 10 Hz.
- You may operate the drive for a maximum load duration of 5 minutes at an output frequency less than 10 Hz, provided that you then select operation with an output frequency higher than 10 Hz for a period of 5 minutes.

NOTICE

Damage to the dv/dt filter compact by exceeding the maximum pulse frequency

The maximum permissible pulse frequency when using a dv/dt filter compact is 4 kHz. The dv/dt filter compact can be damaged if the pulse frequency is exceeded.

- When using the dv/dt filter compact, operate the Motor Module with a maximum pulse frequency of 4 kHz.

NOTICE

Damage to the dv/dt filter compact if it is not activated during commissioning

The dv/dt filter compact may be damaged if it is not activated during commissioning.

- Activate the dv/dt filter compact during commissioning using parameter p0230 = 2.

NOTICE

Damage to the dv/dt filter compact if a motor is not connected

dv/dt filters compact which are operated without a motor being connected can be damaged or destroyed.

- Never operate a dv/dt filter compact connected to the Motor Module without a connected motor.

Note

Cable lengths

Keep the connecting cables to the Motor Module as short as possible (max. 5 m). Use an equivalent cable type when replacing the cables supplied.

7.2.4.3 Interface description

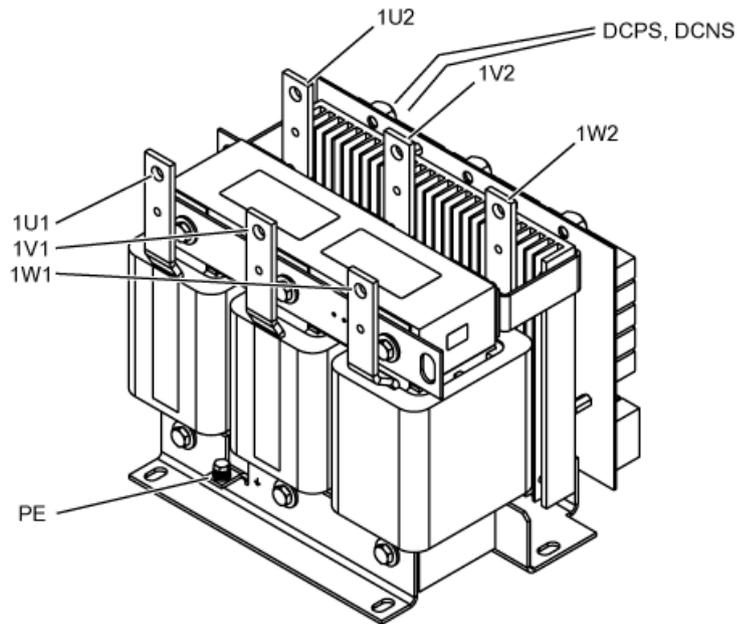


Figure 7-15 Interface overview, dV/dt filter compact plus Voltage Peak Limiter, type 1

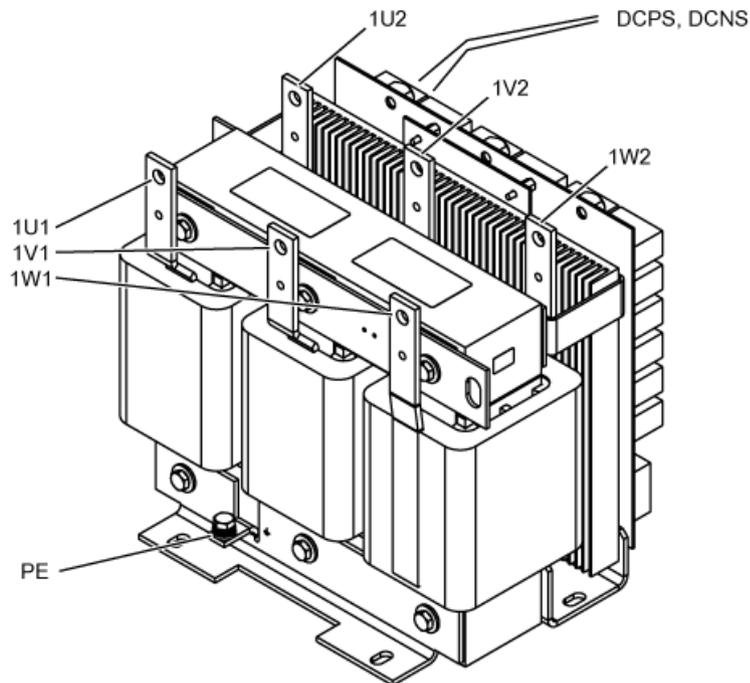


Figure 7-16 Interface overview, dV/dt filter compact plus Voltage Peak Limiter, type 2

7.2.4.4 Connecting the dv/dt filter compact plus Voltage Peak Limiter

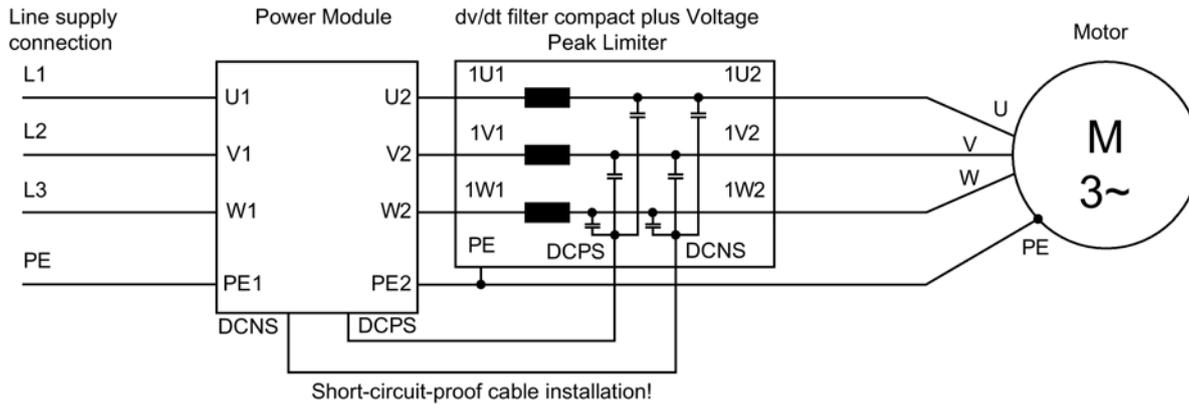


Figure 7-17 Connecting the dV/dt filter compact plus Voltage Peak Limiter

Cable cross-sections

Table 7- 19 Cable cross-sections for connections between a dV/dt filter and Power Module

dV/dt filter compact plus Voltage Peak Limiter	Cross-section [mm ²]	Connection on dV/dt filter
6SL3000-2DE32-6EA0	16 (AWG 6)	Screw M8 / 12 Nm (106 lbf in)
6SL3000-2DE35-0EA0	25 (AWG 4)	Screw M8 / 12 Nm (106 lbf in)

WARNING

Fire due to ground fault / short-circuit

Inadequate installation of the cables to the Motor Module DC link can result in a ground fault/short-circuit and place persons at risk as a result of the associated smoke and fire.

- Apply the local installation regulations to avoid this fault.
- Protect the cables against mechanical damage.
- Also implement one of the following measures:
 - Use cables with double insulation.
 - Maintain adequate clearance, e.g. by using spacers.
 - Lay the cables in separate cable ducts or conduits.

NOTICE

Damage to the du/dt filter compact due to mechanical load on connections

The connections on the dv/dt filter compact have not been designed for the direct mechanical connection of the motor cables.

- Take measures on the installation to ensure that the connections cannot be deformed by the mechanical load exerted by the connected cables.

7.2.4.5 Dimension drawing of dv/dt filter compact plus Voltage Peak Limiter

dV/dt filter compact plus Voltage Peak Limiter, type 1

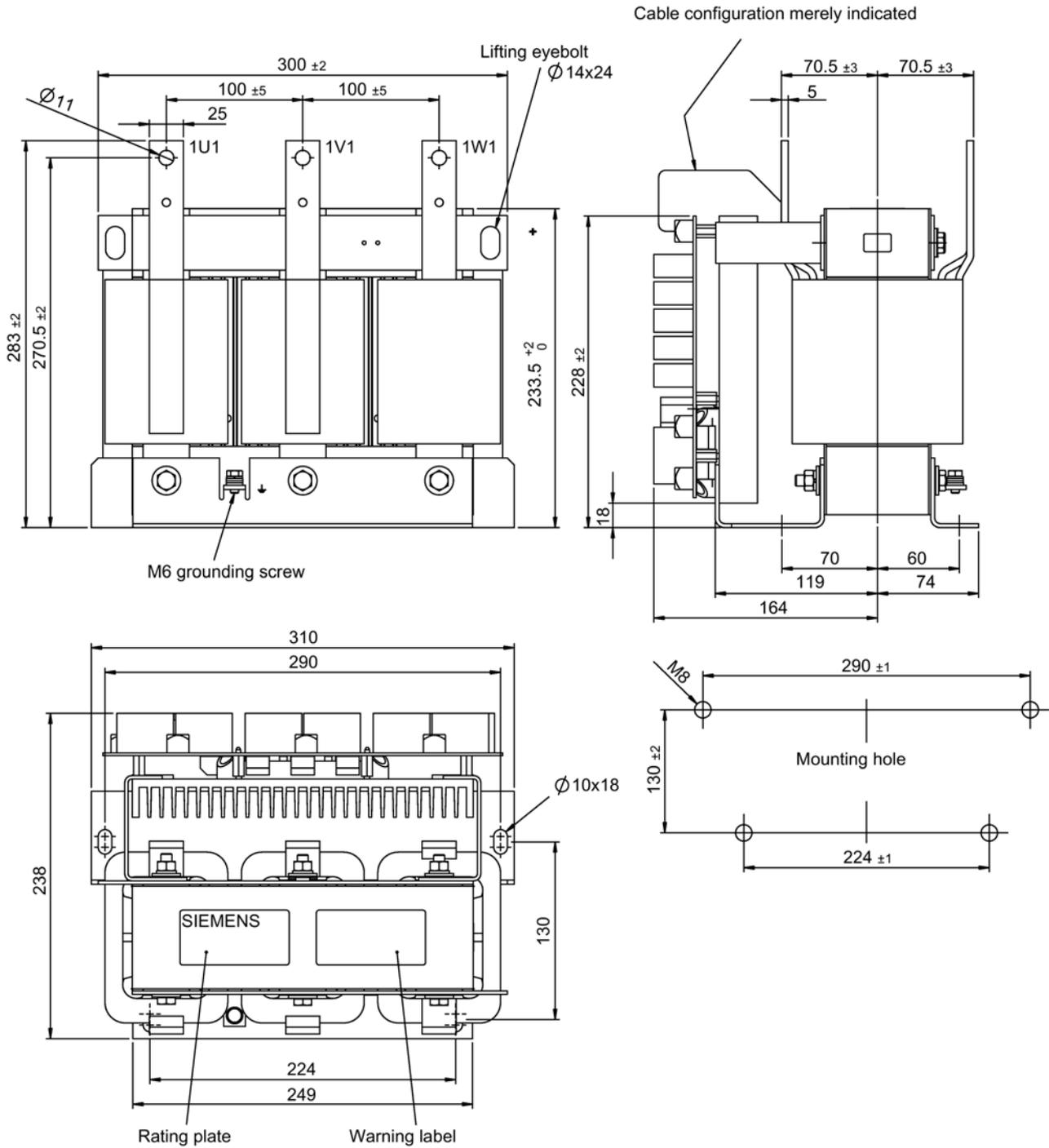


Figure 7-18 Dimension drawing of dV/dt filter compact plus Voltage Peak Limiter, type 1

dV/dt filter compact plus Voltage Peak Limiter, type 2

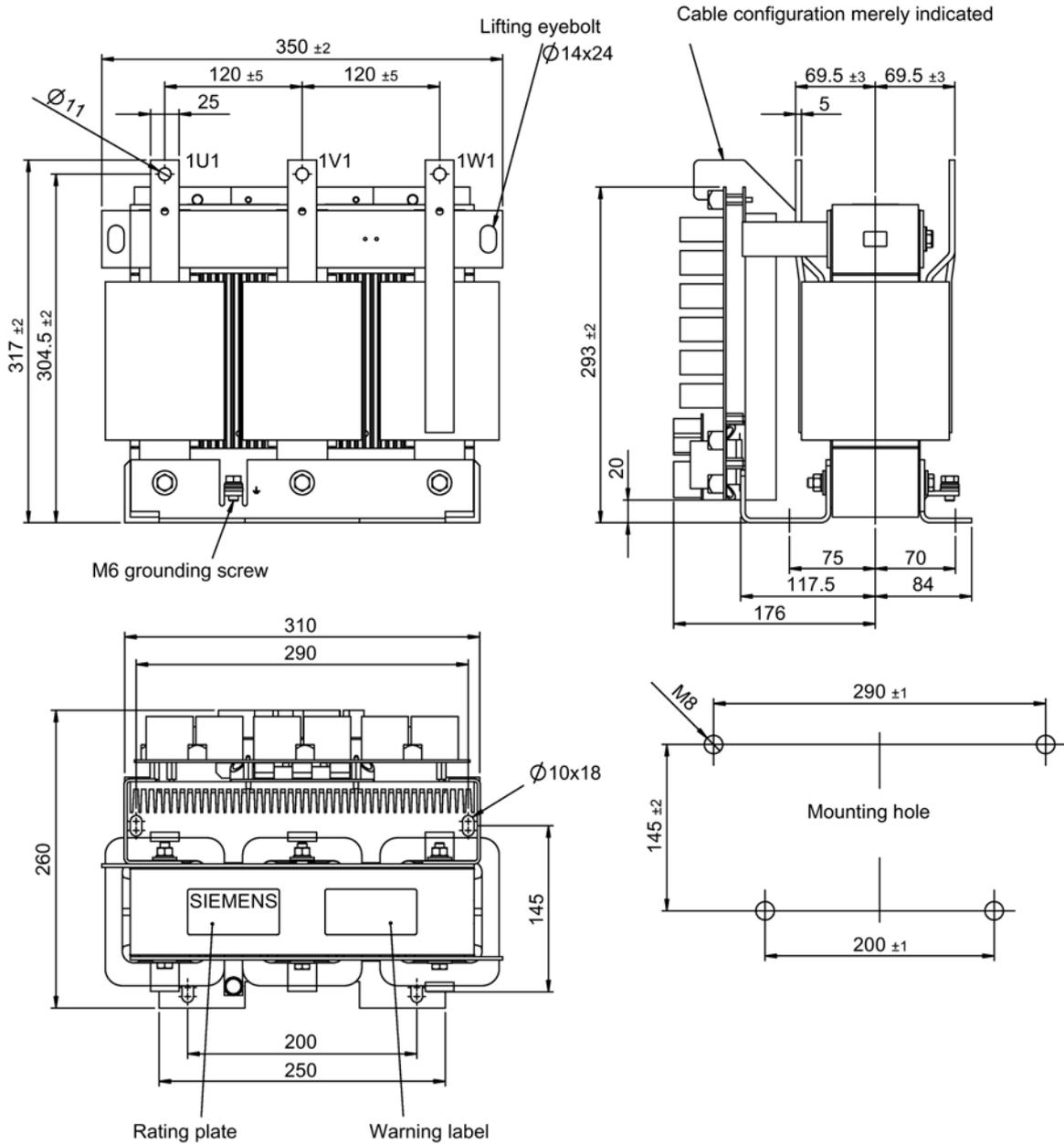


Figure 7-19 Dimension drawing of dV/dt filter compact plus Voltage Peak Limiter, type 2

Table 7- 20 Assignment of the dV/dt filter compact plus Voltage Peak Limiter to the dimension drawings

dV/dt filter compact plus Voltage Peak Limiter	Dimension drawing type
6SL3000-2DE32-6EA0	Type 1
6SL3000-2DE35-0EA0	Type 2

7.2.4.6 Technical data

Table 7- 21 Technical data, dV/dt filter compact plus Voltage Peak Limiter

Article number	6SL3000-	2DE32-6EA0	2DE35-0EA0
Suitable for Power Module (unit rating)	6SL3310-	1TE32-1AA. (110 kW) 1TE32-6AA. (132 kW)	1TE33-1AA. (160 kW) 1TE33-8AA. (200 kW) 1TE35-0AA. (250 kW)
I_{thmax}	A	260	490
Degree of protection		IP00	IP00
Power loss			
- at 50 Hz	kW	0.210	0.290
- at 60 Hz	kW	0.215	0.296
- at 150 Hz	kW	0.255	0.344
Connections			
- 1U1/1V1/1W1		For M10 stud	For M10 stud
- DCPS/DCNS		For M8 screw	For M8 screw
- 1U2/1V2/1W2		For M10 stud	For M10 stud
- protective conductor		M6 screw	M6 screw
Max. permissible cable length between dV/dt filter and motor	m	100 (shielded) 150 (unshielded)	
Dimensions			
Width	mm	310	350
Height	mm	283	317
Depth	mm	238	260
Weight, approx.	kg	41	61

Control Units, Control Unit Adapters and operating components

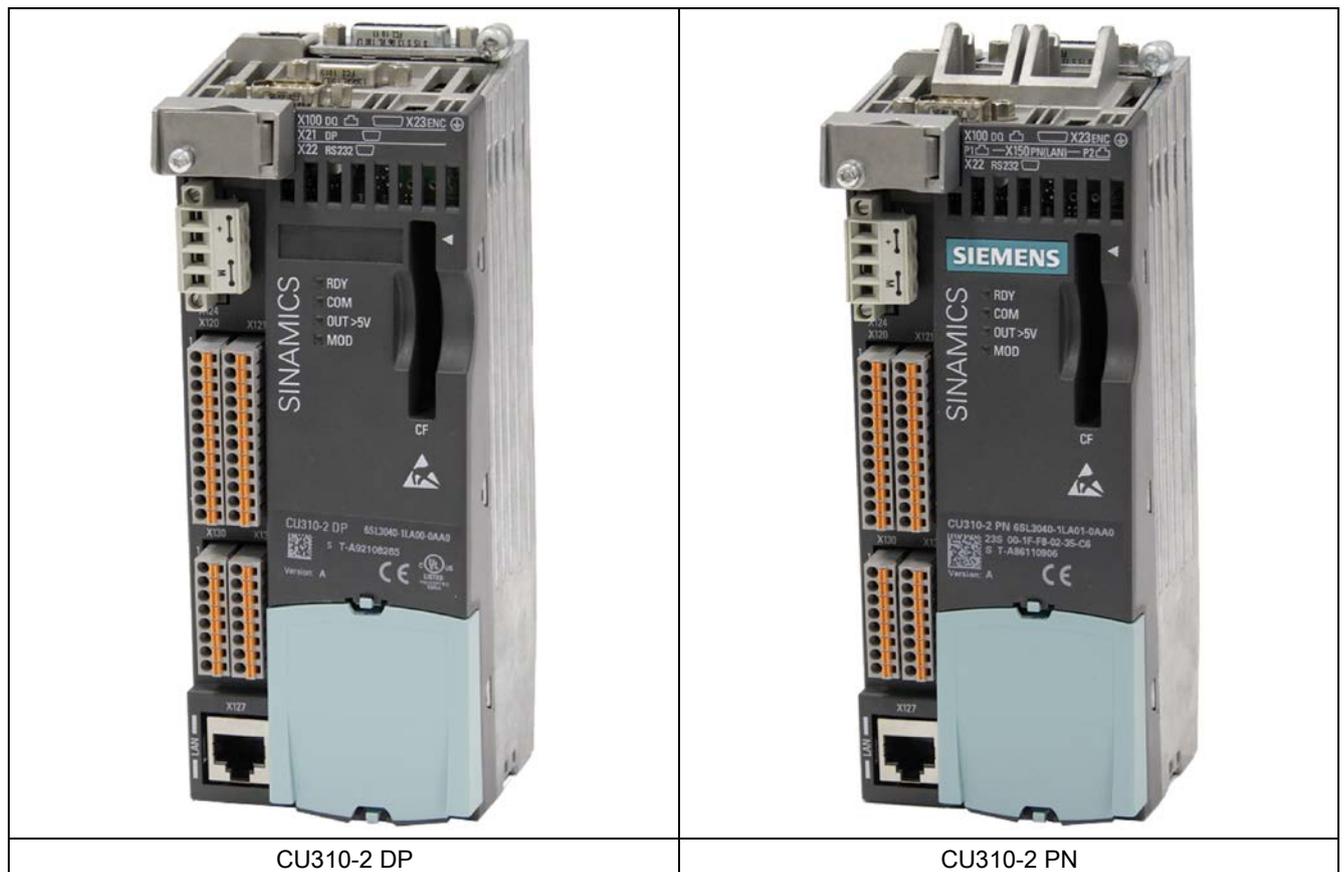
8

8.1 Introduction

8.1.1 Control Units

Brief description

The CU310-2 Controller Units are designed for operation connected to a Power Module, in the blocksize or chassis formats.



Features

Designation	Features	Article number
CU310-2 DP	<ul style="list-style-type: none"> • PROFIBUS as external communications interface • LAN (Ethernet) • TTL / HTL / SSI – encoder evaluation • Analog setpoint input 	6SL3040-1LA00-0AA0
CU310-2 PN	<ul style="list-style-type: none"> • 2x PROFINET as external communications interface • LAN (Ethernet) • TTL / HTL / SSI – encoder evaluation • Analog setpoint input 	6SL3040-1LA01-0AA0

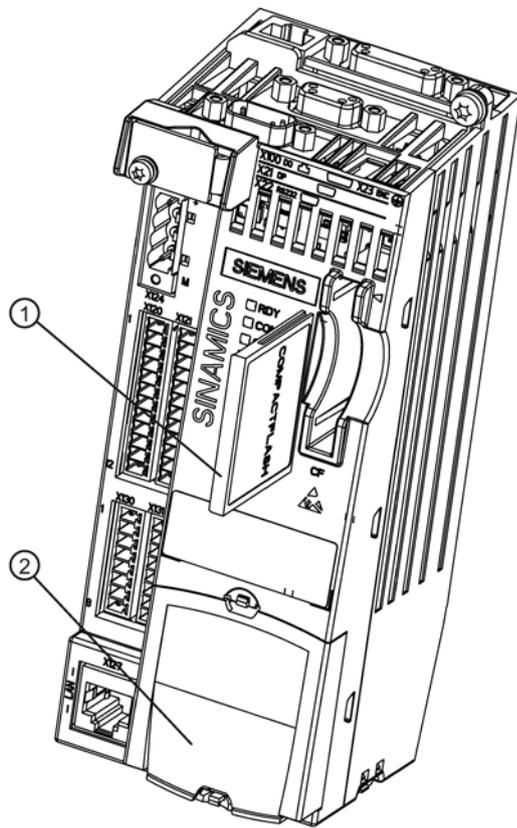
Memory card

The memory card (CompactFlash Card) has the firmware and default parameters for the operation of the Control Unit.

The memory card for the Control Unit must be ordered separately.

Table 8- 1 Article numbers of the memory card

Firmware	without safety license 6SL3054-	with safety license 6SL3054-
V4.4	0EE00-1BA0	0EE00-1BA0-Z F01
V4.5	0EF00-1BA0	0EF00-1BA0-Z F01
V4.6	0EG00-1BA0	0EG00-1BA0-Z F01
V4.7	0EH00-1BA0	0EH00-1BA0-Z F01
V4.8	0EJ00-1BA0	0EJ00-1BA0-Z F01
V5.1	0FB00-1BA0	0FB00-1BA0-Z F01



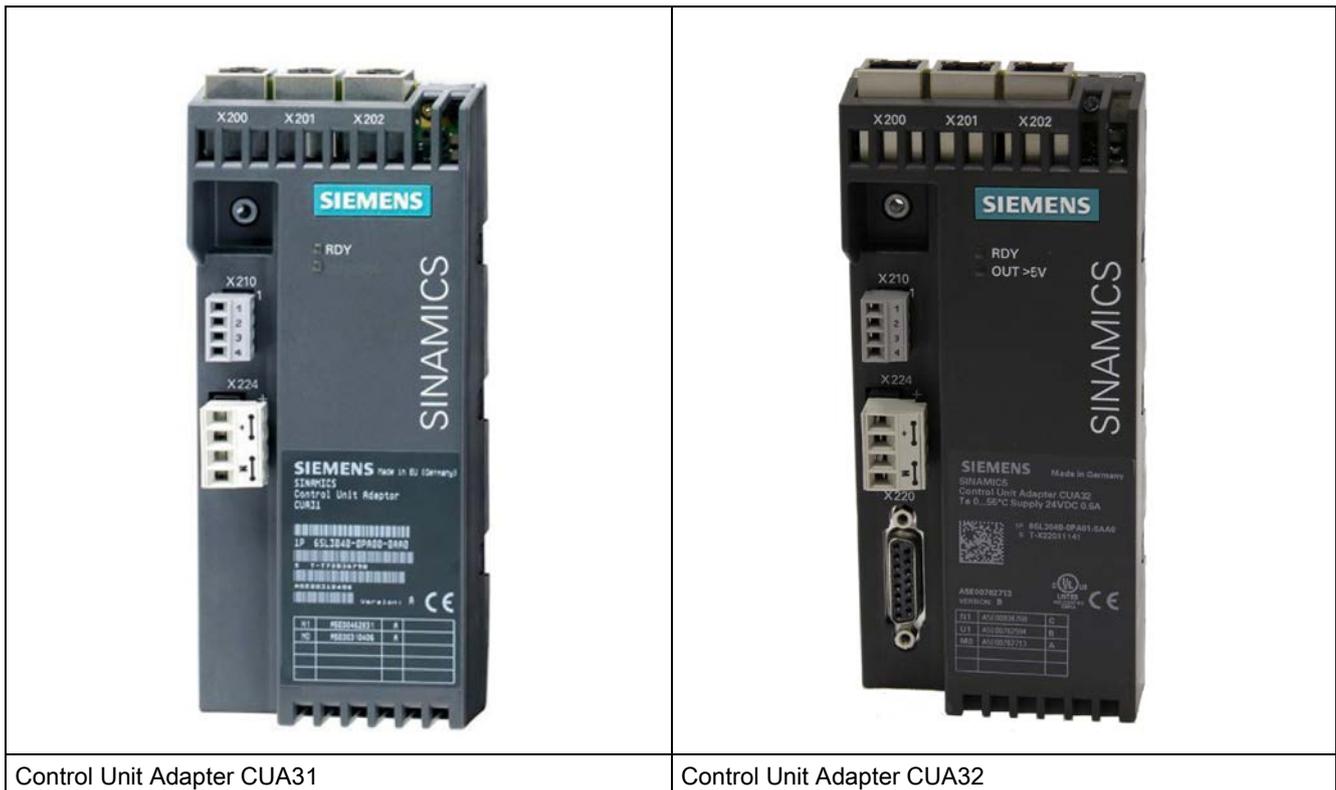
- ① Memory card
- ② Blanking plate

Figure 8-1 CU310-2 DP: CompactFlash Card slot

8.1.2 Control Unit Adapter

Brief description

Using a Control Unit Adapter, a Power Module can be connected as an additional axis to an existing DC/AC group. A higher-level closed-loop control module is always required.



Control Unit Adapter CUA31

Control Unit Adapter CUA32

Features

Designation	Features	Article number
CUA31	<ul style="list-style-type: none"> Addition of an axis 	6SL3040-0PA00-0AA1
CUA32	<ul style="list-style-type: none"> Addition of an axis TTL / HTL / SSI encoder evaluation 	6SL3040-0PA01-0AA0

8.2 Safety instructions for Control Units and Control Unit Adapters

 **WARNING**

Fire through overheating due to insufficient ventilation clearances

Insufficient ventilation clearances result in overheating with danger to persons as a result of smoke and fire. Further, increased failures can occur and the service life of units/systems may be shortened.

- It is essential that you maintain 50 mm ventilation clearances above and below the Control Unit and Control Unit Adapter.
- Ensure that the air openings are not blocked by connecting cables.

 **WARNING**

Danger to life due to software manipulation when using exchangeable storage media

Storing files onto exchangeable storage media amounts to an increased risk of infection, e.g. with viruses and malware. As a result of incorrect parameterization, machines can malfunction, which in turn can lead to injuries or death.

- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.



NOTICE

Memory card damage caused by electric fields or electrostatic discharge

Electrical fields or electrostatic discharge may result in the memory card being damaged.

- When removing and inserting the memory card, always observe the ESD regulations.

NOTICE

Component destruction as a result of high leakage currents

The Control Unit or other PROFIBUS and/or PROFINET nodes can be destroyed, if significant leakage currents flow via the PROFIBUS or PROFINET cable.

- A functional equipotential bonding conductor with a cross-section of at least 10 mm² must be used between components in a system of a plant that are located at a distance from each other.

NOTICE

Device failure due to unshielded or incorrectly laid cables to the temperature sensors

Unshielded or incorrectly laid cables to the temperature sensors can cause induced voltages from the power side to the signal-processing electronics. This can cause massive interferences of all signals (error messages) through to the failure of individual components (damage of the devices).

- Use only shielded cables to the temperature sensors.
- If cables to temperature sensors are laid together with the motor cable, use twisted pairs and separately shielded cables.
- Connect the cable shield to ground potential through a large surface area.
- Recommendation: Use suitable MOTION-CONNECT cables.

NOTICE

Damage caused by the use of incorrect DRIVE-CLiQ cables

Damage or malfunctions can occur on the devices or system when DRIVE-CLiQ cables are used that are either incorrect or have not been approved for this purpose.

- Only use suitable DRIVE-CLiQ cables that have been approved by Siemens for the respective application.

Note

Functional faults caused by dirty DRIVE-CLiQ interfaces

Malfunctions can occur in the system through the use of polluted DRIVE-CLiQ interfaces.

- Close any unused DRIVE-CLiQ interfaces with the supplied cover plates.

Note

Function equipotential bonding for distributed DRIVE-CLiQ nodes

Integrate all of the components that are connected via DRIVE-CLiQ into the function equipotential bonding concept. The connection should be preferably established by mounting on metallic bright machine and plant components that are connected with one another using an equipotential bonding conductor.

Alternatively, you can establish equipotential bonding using a conductor (min. 6 mm²), which as far as possible, is routed in parallel to the DRIVE-CLiQ cable. This involves all distributed DRIVE-CLiQ participants, e.g. SME2□, SME12□ and DME20 (□ = 0 or 5).

8.3 Control Unit CU310-2 PN (PROFINET)

8.3.1 Description

The Control Unit CU310-2 PN (PROFINET) is a control module for single drives in which the open-loop and closed-loop control functions of the drive are implemented.

It controls the Power Modules in the blocksize format via the PM-IF interface and is mounted directly on the Power Module. Power Modules Chassis are controlled from the Control Unit via the DRIVE-CLiQ interface. They are mounted next to the Power Modules in the control cabinet.

The CU310-2 PN is hot-pluggable. It can be used with firmware version 4.4 or higher.

The table shows an overview of the interfaces on the CU310-2 PN.

Table 8- 2 Overview of the CU310-2 PN interfaces

Type	Quantity
Isolated digital inputs	11
Non-isolated digital inputs/outputs	8
Isolated digital output	1
Non-isolated analog input	1
DRIVE-CLiQ interface	1
PROFINET interfaces	2
Serial interface (RS232)	1
Encoder interface (HTL/TTL/SSI)	1
LAN (Ethernet)	1
Temperature sensor input	1
EP terminal	1
Measuring sockets	3

8.3.2 Interface description

8.3.2.1 Overview

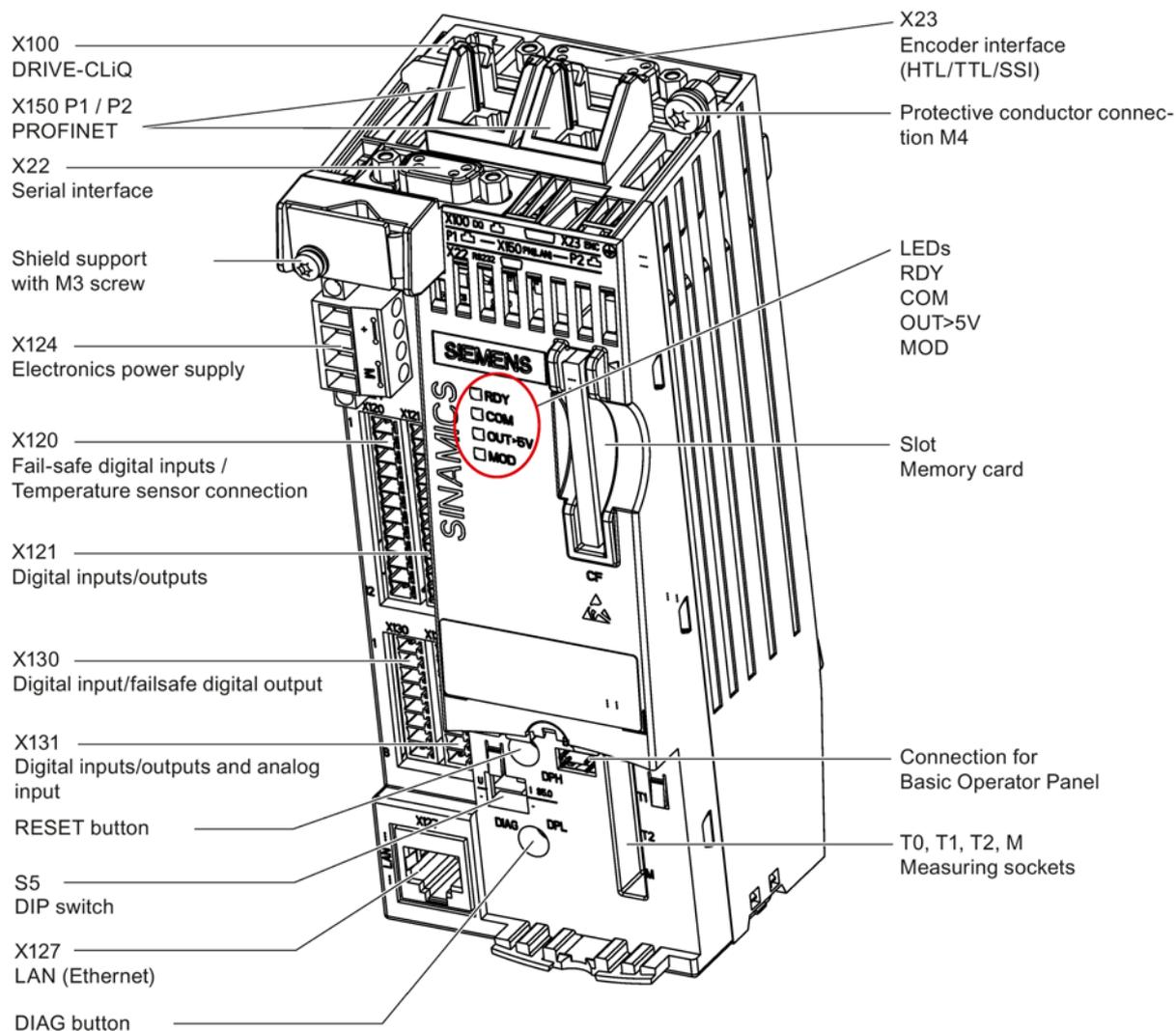


Figure 8-2 CU310-2 PN overview of interfaces

The interface to the Power Module is located at the rear of the CU310-2 PN.

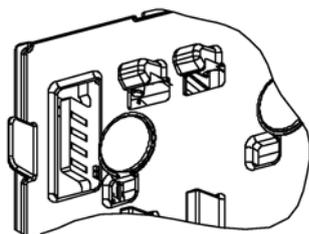
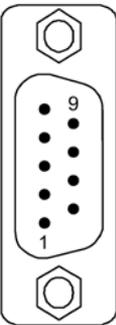


Figure 8-3 CU310-2 PN interface to the Power Module (PM-IF)

8.3.2.2 X22 serial interface (RS232)

Table 8-3 X22 serial interface (RS232)

	Pin	Signal name	Technical data
	1	Reserved, do not use	-
	2	XRXD_RS232	Receive data
	3	XTXD_RS232	Transmit data
	4	Reserved, do not use	-
	5	M	Ground
	6	Reserved, do not use	-
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	9	Reserved, do not use	-
Connector type	9-pin SUB D connector		

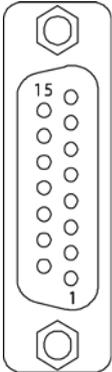
Features

The maximum data rate is:

- 120 kBaud at a load capacity of 1.0 nF
- 20 kBaud at a load capacity of 2.5 nF

8.3.2.3 X23 HTL/TTL/SSI encoder interface

Table 8- 4 X23 HTL/TTL/SSI encoder interface

	Pin	Signal name	Technical data
	1	+Temp	KTY, Pt1000 or PTC input
	2	SSI_CLK	SSI clock, positive
	3	SSI_XCLK	SSI clock, negative
	4	P encoder 5 V / 24 V	Encoder power supply
	5	P encoder 5 V / 24 V	
	6	P_Sense	Sense input encoder power supply
	7	M	Ground, encoder power supply
	8	M (-Temp)	Ground for KTY, Pt1000 or PTC
	9	M_Sense	Ground sense input
	10	RP	R track positive
	11	RN	R track negative
	12	BN	B track negative
	13	BP	B track positive
	14	AN_SSI_XDAT	A track negative / SSI data negative
	15	AP_SSI_DAT	A track positive / SSI data positive
Connector type	15-pin Sub-D socket		
Measuring current via temperature sensor connection: 2 mA			

<p>NOTICE</p> <p>Damage to motor due to incorrectly connected KTY temperature sensor</p> <p>If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.</p> <ul style="list-style-type: none"> • Connect a KTY temperature sensor with the correct polarity.

Note

There are two ways of connecting the temperature sensor:

1. via X120, terminals 1 and 2
2. via X23, pins 1 and 8

Encoders that can be connected

Note

Use of bipolar and unipolar encoders

Use bipolar encoders.

When using unipolar encoders, the unused negative track signals can either be connected or connected to ground. This results in different switching thresholds.

Table 8- 5 Specification of measuring systems that can be connected

Parameter	Designation	Threshold	Min.	Type	Max.	Unit
Permissible signal level in bipolar mode ¹⁾ ; (TTL, SSI, HTL bipolar at X23) ²⁾³⁾	U _{diff}	-	2.0	-	V _{cc}	V
Permissible signal frequency	f _s	-	-	-	500	kHz
Required edge clearance	t _{min}	-	100	-	-	ns
Permissible zero pulse (with T _s = 1/f _s)	Length	-	¼ · T _s	-	¾ · T _s	-
	Center of the pulse position	-	50	135	220	degrees
Switching threshold in the unipolar mode ¹⁾ and signals AN_SSI_XDAT, BN, RN at X23 connected to M_Encoder	U _(Switch)	High ⁴⁾	8.4	10.6	13.1	V
		Low ⁴⁾	3.5	4.8	6.3	V
Switching thresholds in the unipolar mode (see SINAMICS S120/S150 List Manual) and signals AN_SSI_XDAT, BN, RN not connected to X23	U _(Switch)	High ⁴⁾	9	11.3	13.8	V
		Low ⁴⁾	5.9	7.9	10.2	V

1) See SINAMICS S120/S150 List Manual for setting the mode

2) Other signal levels according to the RS422 specification.

3) The absolute level of the individual signals varies between 0 V and V_{cc} of the measuring system.

4) See SINAMICS S120/S150 List Manual for setting the threshold

Encoder cables

Encoder type	Maximum encoder cable length in m
TTL ¹⁾	100
HTL unipolar ²⁾	100
HTL bipolar	300
SSI ³⁾	up to 100 (depending on the baud rate)

1) 100 m with remote sense

2) Because the transmission technology is more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.

3) For the cable length, see the diagram "Maximum cable lengths depending on the SSI baud rate for SSI encoders"

Note

Prefabricated cable for 5 V TTL encoder

When using a 5 V TTL encoder (6FX encoder), use connecting cable 6FX8002-2CR00-....

8.3 Control Unit CU310-2 PN (PROFINET)

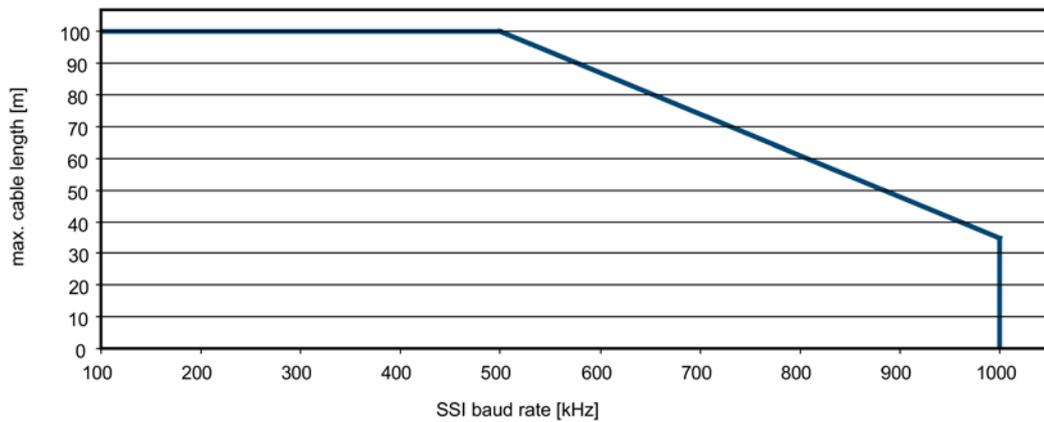


Figure 8-4 Maximum cable lengths depending on the SSI baud rate for SSI encoders

8.3.2.4 X100 DRIVE-CLiQ interface

Table 8- 6 X100 DRIVE-CLiQ interface

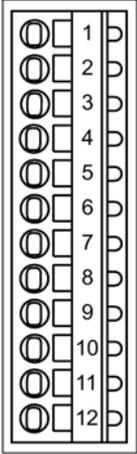
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronic ground
Connector type	DRIVE-CLiQ socket		

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

Blanking covers (50 pieces) Article No.: 6SL3066-4CA00-0AA0

8.3.2.5 X120 digital inputs (fail-safe)/EP terminal/temperature sensor

Table 8- 7 X120 Failsafe Digital Inputs/temperature sensor input

	Terminal	Designation ¹⁾	Technical data	
	1	+ Temp ²⁾	Temperature sensors: KTY84-130 / Pt1000 / PTC Measuring current through temperature sensor connection: 2 mA	
	2	- Temp ²⁾		
	3	DI 16	F-DI 0	Voltage: -3 ... +30 V DC Electrical isolation: yes M1: Reference potential for DI16, DI18 and DI20 DI17-/DI19-/DI21-: Reference potential for DI17/DI19/DI21
	4	DI17+ / EP +24 V3 (Enable Pulses)		
	5	DI17- / EP M3 (Enable Pulses)	F-DI 1	Input characteristic acc. to IEC 61131-2, type 1 Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V
	6	DI 18		
	7	DI 19+	F-DI 2	Input current at 24 V DC: typ. 3.2 mA for "1" signal: > 0.5 mA
	8	DI 19-		
	9	DI 20	F-DI 2	Input delay (typ.) ²⁾ for "0" → "1": 50 μs For "1" → "0": 150 μs
	10	DI 21+		
	11	DI 21-		
	12	M1		
Type: Spring-loaded terminal 1 (Page 384) Max. cross-section that can be connected: 1.5 mm ² (AWG 16)				

1) DI: Digital input; DO: Digital output; F-DI: Fail-safe digital input

2) Control of Power Modules chassis format:+Temp/-Temp deactivated, temperature input via terminal X41 of the Power Modules

3) Pure hardware delay

The maximum cable length that can be connected is 30 m.

Fail-safe digital inputs

An F-DI consists of a digital input and a second digital input to which the cathode of the optocoupler is connected.

Temperature sensor input

NOTICE

Damage to motor due to incorrectly connected KTY temperature sensor

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

- Connect a KTY temperature sensor with the correct polarity.

Further information regarding the temperature sensor may be found in the SINAMICS S120 Commissioning Manual, "Temperature sensors for SINAMICS components" section.

The maximum length of the temperature sensor cable is 300 m. The cables must be shielded. For cable lengths >100 m, cables with a cross-section of $\geq 1 \text{ mm}^2$ must be used.

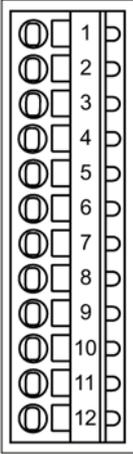
Note

Function of the EP terminals

The function of the EP terminals for pulse inhibit is only available if the "Safety Integrated Basic Functions via onboard terminals" is enabled in the software.

8.3.2.6 X121 digital inputs/outputs

Table 8- 8 X121 digital inputs and bidirectional digital inputs/outputs

	Terminal	Designation ¹⁾	Technical data
	1	DI 0	Voltage: -3 ... +30 V DC
	2	DI 1	Electrical isolation: Yes
	3	DI 2	Reference potential: M2
	4	DI 3	Input characteristic acc. to IEC 61131-2, type 1 Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V (at ≤ 2 mA) Input current at 24 V DC: typ. 3.5 mA For "1" signal: > 0.5 mA Input delay (typ.) For "0" → "1": 50 μs For "1" → "0": 150 μs protected against polarity reversal
	5	M2	Reference potential for digital inputs DI 0 to DI 3
	6	GND	Ground reference for the electronics
	7	DI/DO 8	As input:
	8	DI/DO 9	Voltage: -3 ... +30 V DC
	9	GND	Electrical isolation: no Reference potential: M
	10	DI/DO 10	Input characteristic acc. to IEC 61131-2, type 1
	11	DI/DO 11	Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V (at ≤ 2 mA) Input current at 24 V DC: typ. 3.5 mA For "1" signal: > 0.5 mA Input delay (typ.): For "0" → "1": 5 μs For "1" → "0": 50 μs DI/DO 8, 9, 10 and 11 are fast inputs ²⁾
	12	GND	As output: Voltage: 24 V DC Max. load current per output: 500 mA Output delay (typ. / max.) ³⁾ : For "0" → "1": 150 μs / 400 μs For "1" → "0": 75 μs / 100 μs Short-circuit, ground fault, overload proof Automatic switch on again after overload trip Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W

Type: Spring-loaded terminal 1 (Page 384)

Max. cross-section that can be connected: 1.5 mm² (AWG 16)

	Terminal	Designation ¹⁾	Technical data
--	----------	---------------------------	----------------

- 1) DI: Digital input; DI/DO: Bidirectional digital input/output
- 2) The rapid inputs can be used as probe inputs or as inputs for the external zero mark
- 3) Data for: $V_{cc} = 24\text{ V}$; load $48\ \Omega$; high ("1") = 90% V_{out} ; low ("0") = 10% V_{out}

The maximum cable length that can be connected is 30 m.

Note

An open input is interpreted as "low".

Terminal M2 must be connected so that the digital inputs (DI0 ... DI3) can be used. This is achieved through one of the following measures:

- Provide the ground reference of the digital inputs.
- A jumper to terminal M (this removes the electrical isolation for these digital inputs).

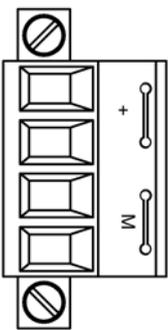
Note

A 24 V supply voltage must be connected to terminal X124 for the digital outputs to be used.

If momentary interruptions in the voltage occur in the 24 V supply, the digital outputs are deactivated until the interruption has been rectified.

8.3.2.7 X124 Electronics power supply

Table 8- 9 X124 Electronics power supply

	Terminal	Designation	Technical data
	+	Electronics power supply	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: Max. 1.0 A (without DRIVE-CLiQ or digital outputs) Max. current via jumper in connector: 20 A (15 A according to UL/CSA)
	+	Electronics power supply	
	M	Electronics ground	
	M	Electronics ground	

Type: Screw-type terminal 2 (Page 384)
 Max. cross-section that can be connected: 2.5 mm² (AWG 14)

The screw terminal must be tightly screwed using a flat-bladed screwdriver.

The maximum cable length that can be connected is 30 m.

If the 24 V supply is not connected, the digital outputs of the following interfaces cannot be used:

- X121 (DO8 to DO11)
- X131 (DO12 to DO15)

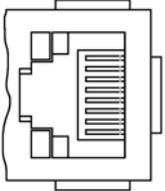
Note

The two "+" and/or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

The current consumption increases by the value for the DRIVE-CLiQ participant and digital outputs.

8.3.2.8 X127 LAN (Ethernet)

Table 8- 10 X127 LAN (Ethernet)

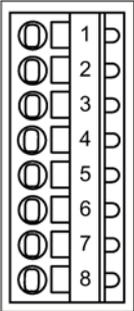
	Pin	Signal name	Technical data
	1	TXP	Ethernet transmit data +
	2	TXN	Ethernet transmit data -
	3	RXP	Ethernet receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Ethernet receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
Connector type	RJ45 socket		

Note

The Ethernet interface supports Auto MDI(X). It is therefore possible to use both crossed and uncrossed cables to connect the devices.

8.3.2.9 X130 digital input (fail safe) digital output

Table 8- 11 X130 Digital Input / Failsafe Digital Output

	Terminal	Designation ¹⁾	Technical data	
	1	DI 22+	Voltage: -3 ... +30 V DC Electrical isolation: Yes Reference potential: M2 Input characteristic acc. to IEC 61131-2, type 1 Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V (at ≤ 2 mA) Input current at 24 V DC: typ. 3.5 mA For "1" signal: > 0.5 mA Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs protected against polarity reversal	
	2	DI 22-		
	3	M2	Reference potential for digital inputs DI 0 to DI 3	
	4	GND	Ground reference for the electronics	
	5	M1	Reference potential for DI 16, DI 18, DI 20 and DO 16	
	6	24 V1	Power supply for DO 16	
	7	DO 16+	F-DO 0 ²⁾	Voltage: 24 V DC Max. Load current per output: 500 mA Output delay (typ./max.): For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Short-circuit, ground fault, overload proof Automatic switch on again after overload trip
	8	DO 16-		
Type: Spring-loaded terminal 1 (Page 384) Max. cross-section that can be connected: 1.5 mm ² (AWG 16)				

1) DI: Digital input/DO: Digital output

2) F-DO: Fail-safe digital output

The maximum cable length that can be connected is 30 m.

Fail-safe digital output

The F-DO consists of a high-side switch and a low-side switch.

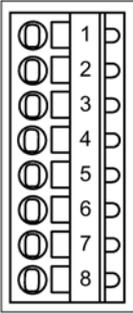
For applications without the safety function, the high-side switch may be used as an additional digital output. The low side switch is not available.

Note

If the 24 V supply is briefly interrupted, the digital output is deactivated until the interruption has been rectified.

8.3.2.10 X131 digital inputs/outputs and analog input

Table 8- 12 X131 bidirectional digital inputs/outputs and analog input

	Terminal	Designation ¹⁾	Technical data
	1	DI/DO 12	As input: Voltage: -3 ... +30 V DC Electrical isolation: no Reference potential: M Input characteristic acc. to IEC 61132-2, type 1 Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V (at ≤ 2 mA) Input current: at 24 V DC: typ. 3.5 mA For "1" signal: > 0.5 mA Input delay (typ.): For "0" → "1": 5 μs For "1" → "0": 50 μs DI/DO 12, 13, 14 and 15 are fast inputs ²⁾ As output: Voltage: 24 V DC Max. load current per output: 500 mA Output delay (typ. / max.) ³⁾ : For "0" → "1": 150 μs / 400 μs For "1" → "0": 75 μs / 100 μs Short-circuit, ground fault, overload proof Automatic switch on again after overload trip Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	2	DI/DO 13	
	3	GND	
	4	DI/DO 14	
	5	DI/DO 15	
	6	GND	Electronics ground
	7	AI 0+	The analog input can be switched between a current or voltage input using DIP switch S5. Common mode range: ±12 V As voltage input: -10 ... +10 V; R _i > 100 kΩ Resolution: 12-bit + sign (with respect to the maximum range that can be resolved -11 V ... 11 V) As current input: -20 ... 20 mA; R _i = 250 Ω Resolution: 11 bit + sign (referred to -22 ... 22 mA) Max. range that can be resolved: -44 ... 44 mA
	8	AI 0-	
Type: Spring-loaded terminal 1 (Page 384) Max. cross-section that can be connected: 1.5 mm ² (AWG 16)			

1) DI/DO: bidirectional digital input/output; AI: Analog input

2) The rapid inputs can be used as probe inputs or as inputs for the external zero mark.

3) Data for: V_{cc} = 24 V; load 48 Ω; high ("1") = 90% V_{out}; low ("0") = 10% V_{out}

The maximum cable length that can be connected is 30 m.

Note

Permissible voltage values at the analog input

The common-mode range must not be violated in order to avoid incorrect results of the analog-digital conversion. This means that the analog differential voltage signals can have a maximum offset voltage of +/- 15 V with respect to the reference potential.

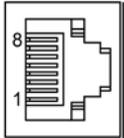
Note

A 24 V supply must be connected to terminal X124 for the digital outputs to be used.

If momentary interruptions in the voltage occur in the 24 V supply, the digital outputs are deactivated until the interruption has been rectified.

8.3.2.11 X150 P1/P2 PROFINET

Table 8- 13 X150 P1 and X150 P2 PROFINET

	Pin	Signal name	Technical data
	1	RXP	Receive data +
	2	RXN	Receive data -
	3	TXP	Transmit data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	TXN	Transmit data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
Connector type:	RJ45 socket		
Data rate:	100 Mbits or 10 Mbits		

Note

The PROFINET interfaces support Auto MDI(X). It is therefore possible to use both crossed and uncrossed cables to connect the devices.

For diagnostic purposes, the two PROFINET interfaces are each equipped with a green and a yellow LED. The table shows the status information these indicate.

Table 8- 14 LED states on the X150 P1/P2 PROFINET interface

LED	Color	Status	Description
Link port	-	OFF	Missing or faulty link
	Green	Continuous light	10 or 100 Mbit link available
Activity port	-	OFF	No activity
	Yellow	Flashing	Data is being received or sent at port x

8.3.2.12 Measuring sockets

Table 8- 15 Measuring sockets T0, T1, T2

	Socket	Function	Technical data
	T0	Measuring socket 0	Voltage: 0 ... V Resolution: 8 bits Load current: max. 3 mA Continued-short-circuit-proof The reference potential is terminal M
	T1	Measuring socket 1	
	T2	Measuring socket 2	
	GND	Ground	
The measuring sockets are only suitable for multiple-spring wire plugs with a diameter of 2 mm.			

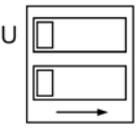
Note

Measuring sockets support commissioning and diagnosis. It must not be connected for normal operation.

8.3.2.13 S5 DIP switch

DIP switch S5 is used to switch the analog input between voltage input and current input. It is located under the blanking cover (see CU310-2 PN Interface Overview (Page 230).)

Table 8- 16 DIP switch S5 - switchover between voltage/current

	Switch	Function
	S5.0	Switchover between voltage (U) / current (I)
	S5.1	Not assigned

8.3.2.14 DIAG button

The DIAG pushbutton is reserved for service functions.

8.3.2.15 RESET button

Pressing the RESET button restarts the CU310-2 PN after expiry of a preset time. A data backup is run at the same time. This means that all the settings are retained.

8.3.2.16 Memory card

Inserting the memory card

Use only memory cards manufactured by Siemens to run the CU310-2 PN.

Insert the memory card into the CU310-2 PN so that the arrow on the card's label (on the left, next to the word Siemens) points to the arrow on the device.



Figure 8-5 CU310-2 PN Inserting the memory card

The memory card in a faulty CU310-2 PN

If you are returning a faulty CU310-2 PN to Siemens, remove the memory card and keep it in a safe place.

This ensures that all your saved data (firmware, licenses, parameters) will be available to you immediately again to commission a replacement unit.

8.3.3 Connection examples

CU310-2 PN without safety function

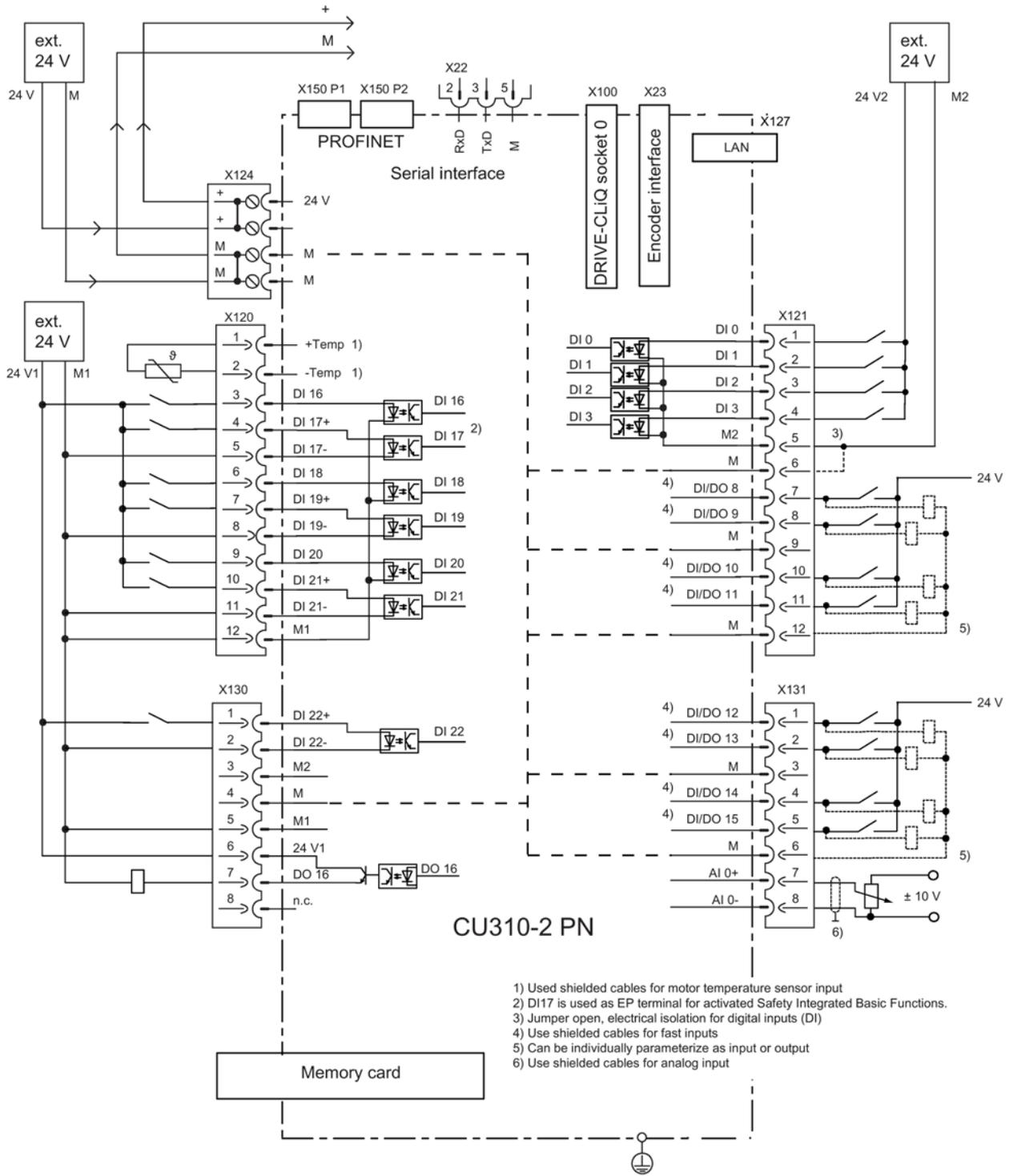


Figure 8-6 Connection example, CU310-2 PN without safety function

CU310-2 PN with safety function

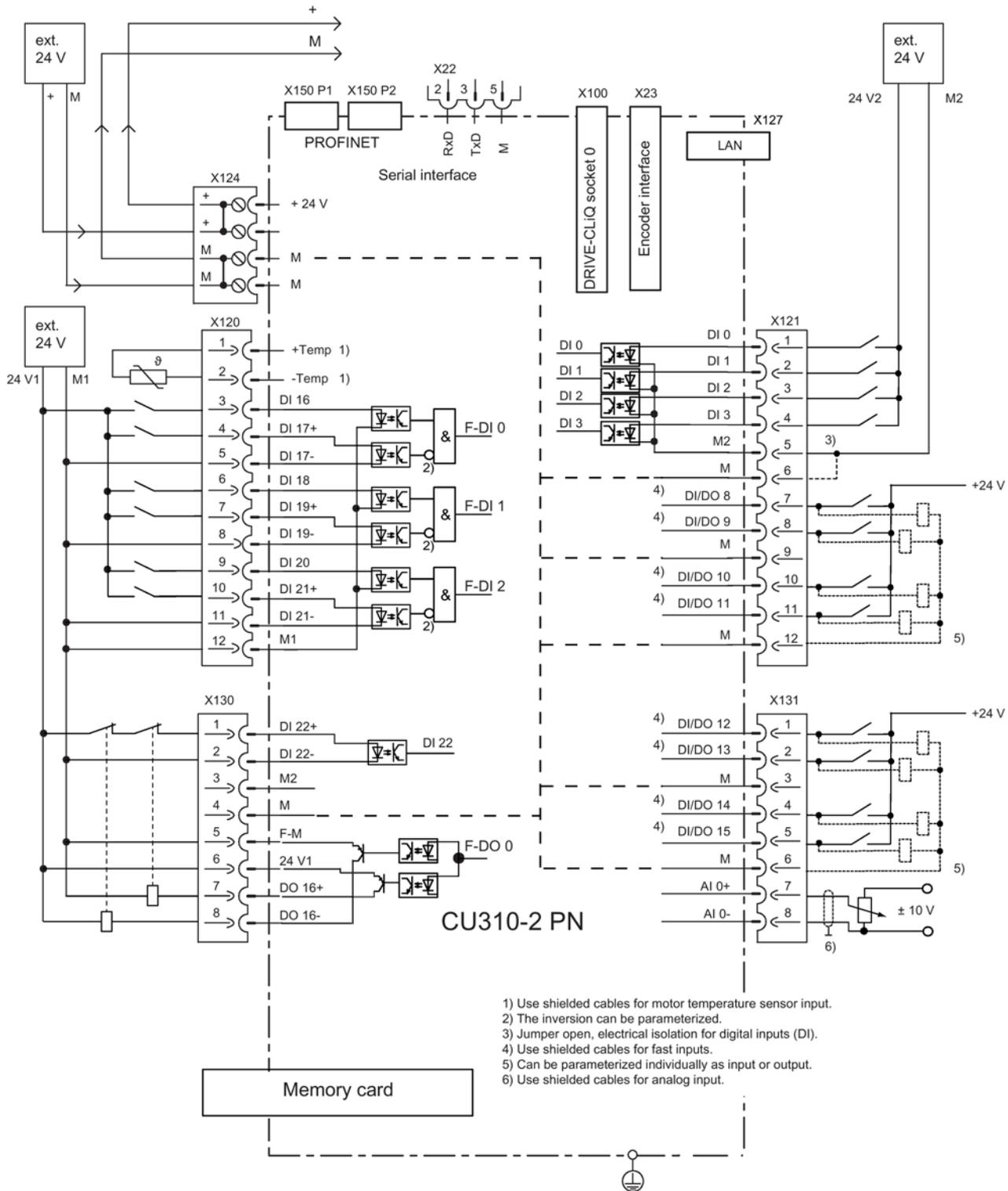


Figure 8-7 Connection example, CU310-2 PN with safety function

8.3.4 Meaning of the LEDs

8.3.4.1 Function of the LEDs

There are four LEDs on the front panel of the CU310-2 PN's housing (see CU310-2 PN Interface Overview (Page 230).)

Table 8- 17 LEDs

RDY	Ready
COM	Status of the fieldbus communication
OUT>5V	Encoder current supply > 5 V (TTL/HTL)
MOD	Operating mode (reserved)

The various LEDs are switched on and off as the control unit is powered up (depending on the phase the system is currently in). When switched on, the color of the LEDs shows the status of the corresponding power-up phase (see Behavior of the LEDs during booting (Page 247)).

In the event of a fault, power up will be ended in the corresponding phase. The LEDs that are switched on retain their color at this particular instant in time, so that the fault can be determined based on the combination of LEDs that are switched on (bright) and switched off (dark).

All the LEDs go out briefly if the CU310-2 PN has powered up without error. The system is ready for operation when the LED "RDY" is permanently green.

All the LEDs are controlled by the software loaded during operation (see Behavior of the LEDs in the operating state (Page 248).)

8.3.4.2 Behavior of the LEDs during booting

Table 8- 18 Load software

LED				State	Comment
RDY	COM	OUT>5V	MOD		
Orange	Orange	Orange	Orange	POWER ON	All LEDs light up for approx. 1 s
Red	Red	Off	Off	Hardware reset	After pressing the RESET button the LEDs light up for approx. 1 s
Red	Red	Off	Off	BIOS loaded	-
Red Flashing light 2 Hz	Red	Off	Off	BIOS error	Error occurred while loading the BIOS
Red Flashing light 2 Hz	Red Flashing light 2 Hz	Off	Off	File error	Memory card not inserted or faulty Software on memory card not present or corrupted

8.3 Control Unit CU310-2 PN (PROFINET)

Table 8- 19 Firmware

LED				State	Comment
RDY	COM	OUT>5V	MOD		
Red	Orange	Off	Off	Firmware loading	COM-LED flashing without specific flashing frequency
Red	Off	Off	Off	Firmware loaded	-
Off	Red	Off	Off	Firmware check (no CRC error)	-
Red Flashing light 0.5 Hz	Red Flashing light 0.5 Hz	Off	Off	Firmware check (CRC error)	CRC is incorrect
Orange	Off	Off	Off	Firmware initialization	-

8.3.4.3 Behavior of the LEDs in the operating state

Table 8- 20 Description of the LEDs during operation of the CU310-2 PN

LED	Color	State	Description / cause	Remedy
RDY (READY)	-	OFF	The electronics power supply is missing or outside the permissible tolerance range.	Check the power supply.
	Green	Continuous light	The unit is ready for operation. Cyclic DRIVE-CLiQ communication is in progress.	-
		Flashing light 0.5 Hz	Commissioning/reset	-
		Flashing light 2 Hz	Writing to the memory card.	-
		Flashing light - 0.5 s on 3 s off	PROFenergy energy saving mode is active. More detailed information, see Function Manual "SINAMICS S120 Drive Functions".	-
	Red	Flashing light 2 Hz	General fault	Check parameter assignment/configuration
	Red/green	Flashing light 0.5 Hz	The control unit is ready for operation, but there are no software licenses.	Install the missing licenses.
	Orange	Flashing light 0.5 Hz	Updating the firmware of the DRIVE-CLiQ components.	-
		Flashing light 2 Hz	DRIVE-CLiQ component firmware update completed. Waiting for POWER ON of the corresponding components.	Switch on the component.
Green/orange or red/orange	Flashing light 2 Hz	Recognition of the component via LED is activated (see SINAMICS S120/S150 List Manual.) Remark: Both options depend on the LED status when component recognition is activated.	-	

LED	Color	State	Description / cause	Remedy
COM	-	OFF	Cyclic communication has not (yet) taken place. Remark: PROFIdrive is ready for communication when the Control Unit is ready (see LED: RDY).	-
	Green	Continuous light	Cyclic communication is taking place.	-
		Flashing light 0.5 Hz	Full cyclic communication is not yet taking place. Possible causes: <ul style="list-style-type: none"> The controller is not transferring any setpoints. For isochronous operation, synchronization has still not been completed. 	-
	Red	Flashing light 0.5 Hz	Bus error, incorrect parameter assignment/configuration	Adapt the configuration between the controller and the devices.
		Flashing light 2 Hz	Cyclic bus communication has been interrupted or could not be established.	Rectify the fault in bus communication.
MOD	-	OFF	-	-
OUT > 5 V	-	OFF	-	-
	Orange	Continuous light	The voltage of the electronics power supply for the measuring system is 24 V. ¹⁾	

¹⁾ Make sure that the encoder connected is designed for a 24 V supply. Connecting a 5 V encoder to a 24 V supply can result in destruction of the encoder electronics.

8.3.5 Dimension drawing

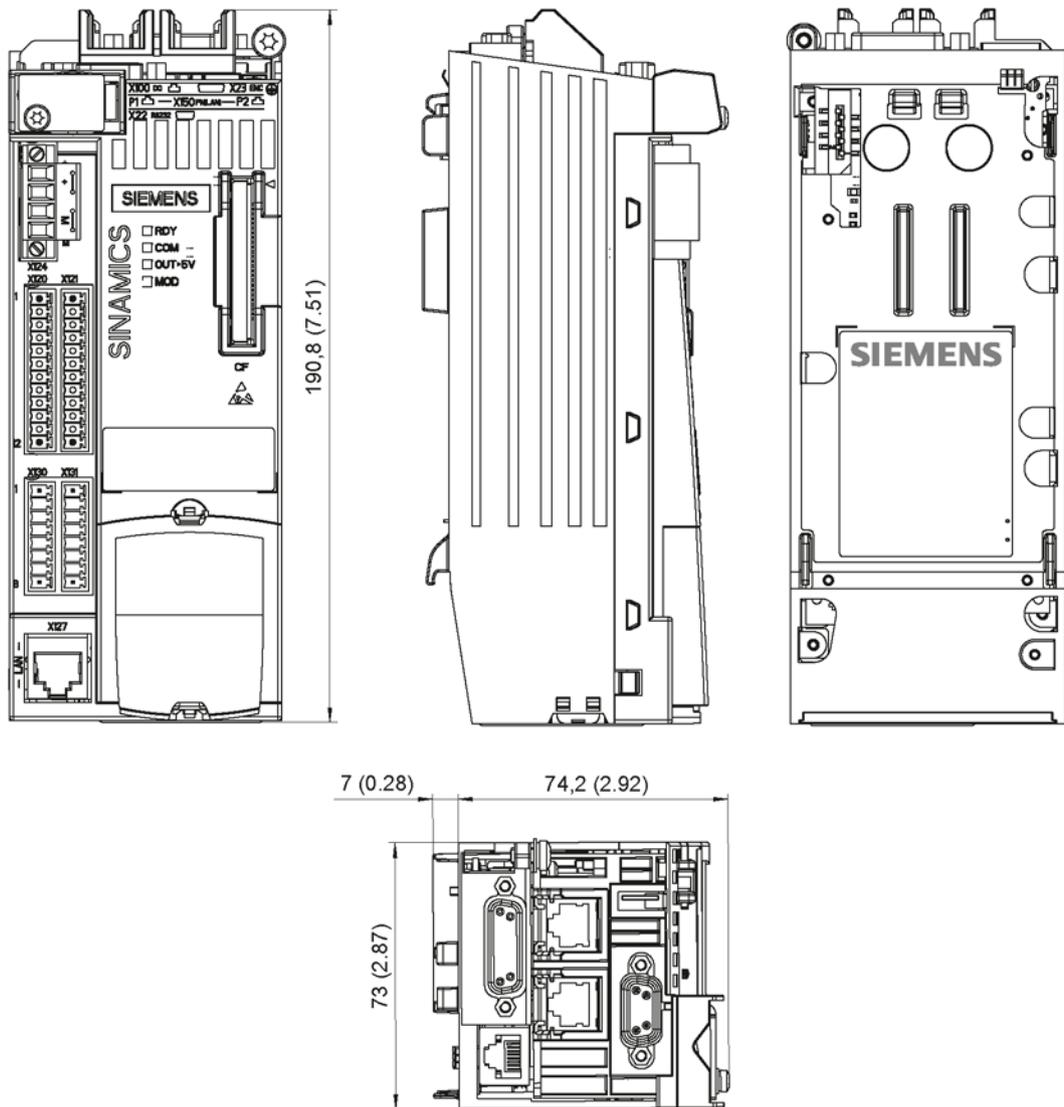


Figure 8-8 Dimension drawing, Control Unit CU310-2 PN, all data in mm (inches)

8.3.6 Technical data

Table 8- 21 Technical data for CU310-2 PN

6SL3040-1LA01-0AA0	Unit	Value
Ambient temperature in operation	°C	0 ... 60
Electronics power supply		
Voltage	V _{DC}	24 DC (20.4 ... 28.8)
Current (without DRIVE-CLiQ and digital outputs)	A _{DC}	0.8
Power loss	W	< 20
Maximum DRIVE-CLiQ cable length	m	100
Protective conductor/ground connection	At the housing with screw M4/3 Nm (26.6 lbf in)	
Response time	The response time of digital inputs/outputs depends on the evaluation. ¹⁾	
Weight	kg	0.95

1) You will find information on this topic in the SINAMICS S120/S150 List Manual, Chapter "Function block diagrams".

8.4 Control Unit CU310-2 DP (PROFIBUS)

8.4.1 Description

The CU310-2 DP Control Unit (PROFIBUS) is a control module for single-motor drives in which the open-loop and closed-loop control functions of the drive are implemented. It controls the Power Modules in the blocksize format via the PM-IF interface. Power Modules Chassis are controlled from the Control Unit via the DRIVE-CLiQ interface.

The CU310-2 DP is hot-pluggable. It can be used with firmware version 4.4 or higher.

The table shows an overview of the interfaces on the CU310-2 DP.

Table 8- 22 Overview of interfaces on the CU310-2 DP

Type	Quantity
Isolated digital inputs	11
Non-isolated digital inputs/outputs	8
Isolated digital output	1
Non-isolated analog input	1
DRIVE-CLiQ interface	1
PROFIBUS interface	1
Serial interface (RS232)	1
Encoder interface (HTL/TTL/SSI)	1
LAN (Ethernet)	1
Temperature sensor input	1
EP terminal	1
Measuring sockets	3

8.4.2 Interface description

8.4.2.1 Overview

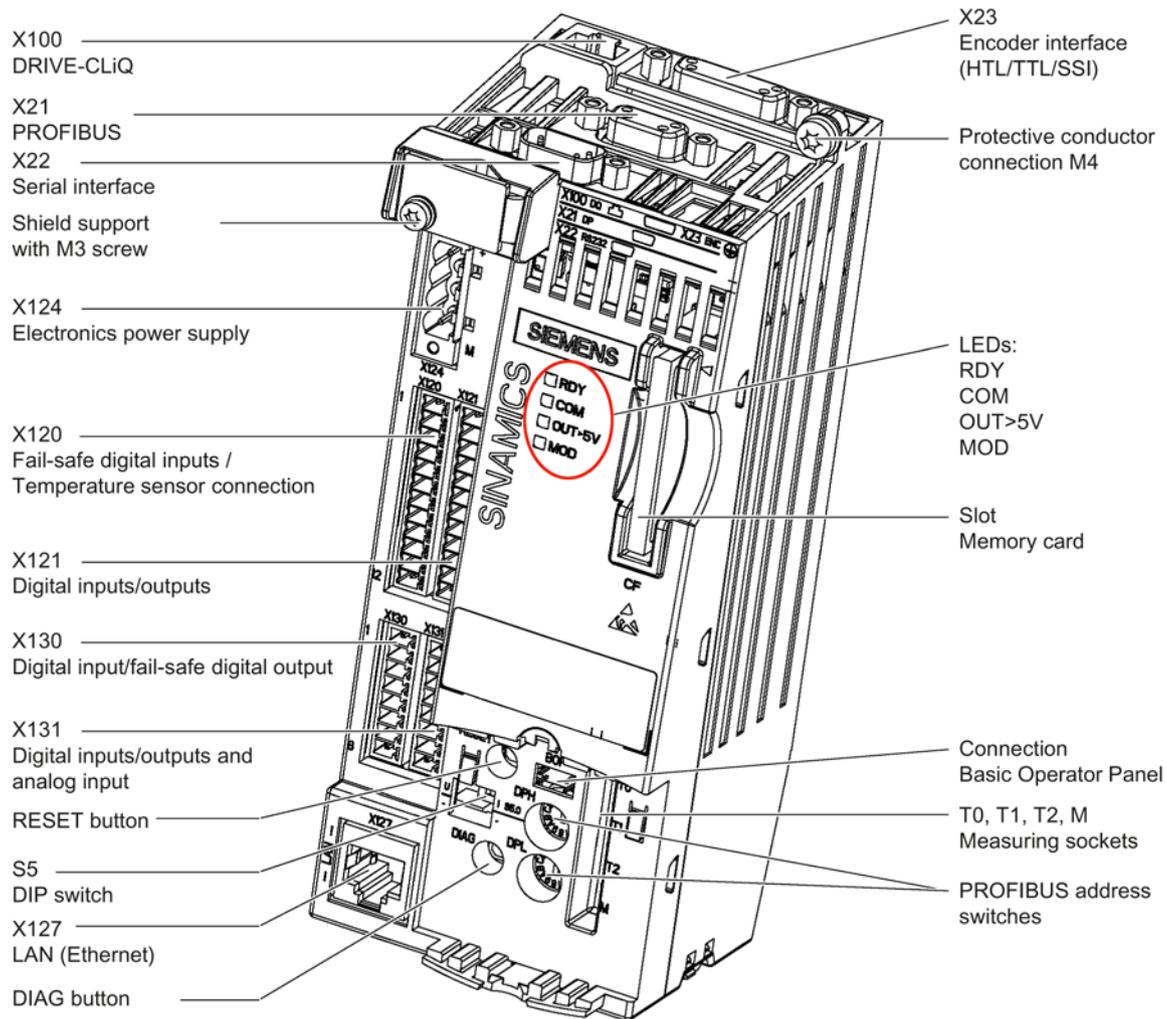


Figure 8-9 CU310-2 DP interface overview

The interface to the Power Module is located at the rear of the CU310-2 DP.

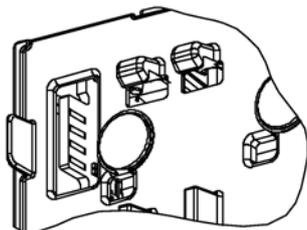
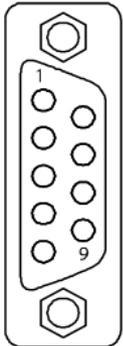


Figure 8-10 CU310-2 DP interface to the Power Module (PM-IF)

8.4.2.2 X21 PROFIBUS

The PROFIBUS interface X21 can be operated isochronously.

Table 8- 23 X21 PROFIBUS interface

	Pin	Signal name	Meaning	Range
	1	-	Not assigned	
	2	M24_SERV	Teleservice supply, ground	0 V
	3	RxD/TxD-P	Receive/transmit data P (B)	RS485
	4	CNTR-P	Control signal	TTL
	5	DGND	PROFIBUS data reference potential	
	6	VP	Supply voltage plus	5 V ± 10 %
	7	P24_SERV	Power supply for teleservice, + (24 V)	24 V (20.4 ... 28.8 V)
	8	RxD/TxD-N	Receive/transmit data N (A)	RS485
	9	-	Not assigned	
Connector type	9-pin Sub-D socket			

Note

A teleservice adapter can be connected to the PROFIBUS interface X21 for remote diagnostics.

The power supply for the teleservice (terminals 2 and 7) can have a max. load of 150 mA.

PROFIBUS connector

For the first and last participants in a bus line, the terminating resistors must be switched in, otherwise, data transmission will not function correctly.

The terminating resistors are activated in the connector.

The cable shield must be connected at both ends over large-surface area contacts.

8.4.2.3 PROFIBUS address switch

The PROFIBUS address for the CU310-2 DP is set as a hexadecimal value on two rotary coding switches.

Values may be set between 0_{dec} (00_{hex}) and 127_{dec} (7F_{hex}).

The upper rotary coding switch (H) is used to set the hexadecimal value for 16¹ and the lower rotary coding switch (L) is used to set the hexadecimal value for 16⁰.

Table 8- 24 PROFIBUS address switch

Rotary coding switches	Significance	Examples		
		21 _{dec}	35 _{dec}	126 _{dec}
		15 _{hex}	23 _{hex}	7E _{hex}
	16 ¹ = 16	1	2	7
	16 ⁰ = 1	5	3	E

Setting the PROFIBUS address

The factory setting for the rotary coding switches is 0_{dec} (00_{hex}).

The PROFIBUS address is set as follows:

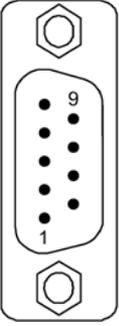
1. via a parameter (see SINAMICS S120/S150 List Manual)
 - To set the bus address for a PROFIBUS node using STARTER, first set the rotary code switches to 0_{dec} (00_{hex}) and 127_{dec} (7F_{hex}).
 - Then use the parameter to set the address to a value between 1 and 126.
2. via PROFIBUS address switch
 - The PROFIBUS address is set manually to a value between 1 and 126 on the two rotary coding switches. In this case the address is merely read out via the parameter.

Note

The rotary coding switches used to set the PROFIBUS address are found beneath the blanking cover (see CU310-2 DP Interface Overview (Page 252))

8.4.2.4 X22 serial interface (RS232)

Table 8- 25 X22 serial interface (RS232)

	Pin	Signal name	Technical data
	1	Reserved, do not use	-
	2	XRXD_RS232	Receive data
	3	XTXD_RS232	Transmit data
	4	Reserved, do not use	-
	5	M	Ground
	6	Reserved, do not use	-
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	9	Reserved, do not use	-
Connector type	9-pin SUB D connector		

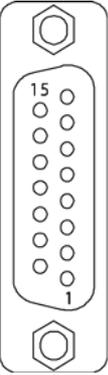
Features

The maximum data rate is:

- 120 kBaud at a load capacity of 1.0 nF
- 20 kBaud at a load capacity of 2.5 nF

8.4.2.5 X23 HTL/TTL/SSI encoder interface

Table 8- 26 X23 HTL/TTL/SSI encoder interface

	Pin	Signal name	Technical data
	1	+Temp	KTY, Pt1000 or PTC input
	2	SSI_CLK	SSI clock, positive
	3	SSI_XCLK	SSI clock, negative
	4	P encoder 5 V / 24 V	Encoder power supply
	5	P encoder 5 V / 24 V	
	6	P_Sense	Sense input encoder power supply
	7	M	Ground, encoder power supply
	8	M (-Temp)	Ground for KTY, Pt1000 or PTC
	9	M_Sense	Ground sense input
	10	RP	R track positive
	11	RN	R track negative
	12	BN	B track negative
	13	BP	B track positive
	14	AN_SSI_XDAT	A track negative / SSI data negative
	15	AP_SSI_DAT	A track positive / SSI data positive
Connector type	15-pin Sub-D socket		
Measuring current via temperature sensor connection: 2 mA			

NOTICE
Damage to motor due to incorrectly connected KTY temperature sensor
If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.
<ul style="list-style-type: none"> Connect a KTY temperature sensor with the correct polarity.

Note

There are two ways of connecting the temperature sensor:

- via X120, terminals 1 and 2
- via X23, pins 1 and 8

Encoders that can be connected

Note

Use of bipolar and unipolar encoders

Use bipolar encoders.

When using unipolar encoders, the unused negative track signals can either be connected or connected to ground. This results in different switching thresholds.

Table 8- 27 Specification of measuring systems that can be connected

Parameter	Designation	Threshold	Min.	Type	Max.	Unit
Permissible signal level in bipolar mode ¹⁾ ; (TTL, SSI, HTL bipolar at X23) ²⁾³⁾	U _{diff}	-	2.0	-	V _{cc}	V
Permissible signal frequency	f _s	-	-	-	500	kHz
Required edge clearance	t _{min}	-	100	-	-	ns
Permissible zero pulse (with T _s = 1/f _s)	Length	-	¼ · T _s	-	¾ · T _s	-
	Center of the pulse position	-	50	135	220	degrees
Switching threshold in the unipolar mode ¹⁾ and signals AN_SSI_XDAT, BN, RN at X23 connected to M_Encoder	U _(Switch)	High ⁴⁾	8.4	10.6	13.1	V
		Low ⁴⁾	3.5	4.8	6.3	V
Switching thresholds in the unipolar mode (see SINAMICS S120/S150 List Manual) and signals AN_SSI_XDAT, BN, RN not connected to X23	U _(Switch)	High ⁴⁾	9	11.3	13.8	V
		Low ⁴⁾	5.9	7.9	10.2	V

1) See SINAMICS S120/S150 List Manual for setting the mode
 2) Other signal levels according to the RS422 specification.
 3) The absolute level of the individual signals varies between 0 V and V_{cc} of the measuring system.
 4) See SINAMICS S120/S150 List Manual for setting the threshold

Encoder cables

Encoder type	Maximum encoder cable length in m
TTL ¹⁾	100
HTL unipolar ²⁾	100
HTL bipolar	300
SSI ³⁾	up to 100 (depending on the baud rate)

- 1) 100 m with remote sense
- 2) Because the transmission technology is more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.
- 3) For the cable length, see the diagram "Maximum cable lengths depending on the SSI baud rate for SSI encoders"

Note

Prefabricated cable for 5 V TTL encoder

When using a 5 V TTL encoder (6FX encoder), use connecting cable 6FX8002-2CR00-....

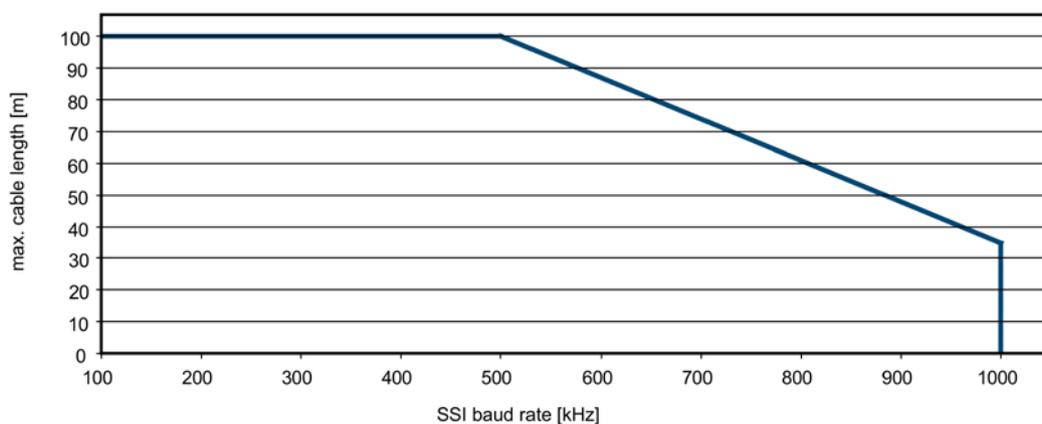
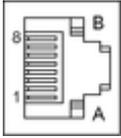


Figure 8-11 Maximum cable lengths depending on the SSI baud rate for SSI encoders

8.4.2.6 X100 DRIVE-CLiQ interface

Table 8- 28 X100 DRIVE-CLiQ interface

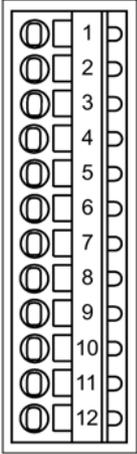
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronic ground
	Connector type	DRIVE-CLiQ socket	

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

Blanking covers (50 pieces) Article No.: 6SL3066-4CA00-0AA0

8.4.2.7 X120 digital inputs (fail-safe)/EP terminal/temperature sensor

Table 8- 29 X120 Failsafe Digital Inputs/temperature sensor input

	Terminal	Designation ¹⁾	Technical data	
	1	+ Temp ²⁾	Temperature sensors: KTY84-130 / Pt1000 / PTC Measuring current through temperature sensor connection: 2 mA	
	2	- Temp ²⁾		
	3	DI 16	F-DI 0	Voltage: -3 ... +30 V DC Electrical isolation: yes M1: Reference potential for DI16, DI18 and DI20 DI17-/DI19-/DI21-: Reference potential for DI17/DI19/DI21
	4	DI17+ / EP +24 V3 (Enable Pulses)		
	5	DI17- / EP M3 (Enable Pulses)	F-DI 1	Input characteristic acc. to IEC 61131-2, type 1 Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V
	6	DI 18		
	7	DI 19+	F-DI 2	Input current at 24 V DC: typ. 3.2 mA for "1" signal: > 0.5 mA
	8	DI 19-		
	9	DI 20	F-DI 2	Input delay (typ.) ²⁾ for "0" → "1": 50 μs For "1" → "0": 150 μs
	10	DI 21+		
	11	DI 21-		
	12	M1		
Type: Spring-loaded terminal 1 (Page 384) Max. cross-section that can be connected: 1.5 mm ² (AWG 16)				

1) DI: Digital input; DO: Digital output; F-DI: Fail-safe digital input

2) Control of Power Modules chassis format:+Temp/-Temp deactivated, temperature input via terminal X41 of the Power Modules

3) Pure hardware delay

The maximum cable length that can be connected is 30 m.

Fail-safe digital inputs

An F-DI consists of a digital input and a second digital input to which the cathode of the optocoupler is connected.

Temperature sensor input

NOTICE

Damage to motor due to incorrectly connected KTY temperature sensor

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

- Connect a KTY temperature sensor with the correct polarity.

Further information regarding the temperature sensor may be found in the SINAMICS S120 Commissioning Manual, "Temperature sensors for SINAMICS components" section.

The maximum length of the temperature sensor cable is 300 m. The cables must be shielded. For cable lengths >100 m, cables with a cross-section of $\geq 1 \text{ mm}^2$ must be used.

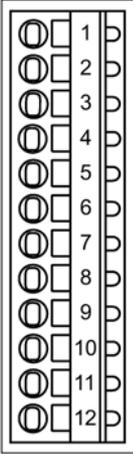
Note

Function of the EP terminals

The function of the EP terminals for pulse inhibit is only available if the "Safety Integrated Basic Functions via onboard terminals" is enabled in the software.

8.4.2.8 X121 digital inputs/outputs

Table 8- 30 X121 digital inputs and bidirectional digital inputs/outputs

	Terminal	Designation ¹⁾	Technical data
	1	DI 0	Voltage: -3 ... +30 V DC
	2	DI 1	Electrical isolation: Yes
	3	DI 2	Reference potential: M2
	4	DI 3	Input characteristic acc. to IEC 61131-2, type 1 Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V (at ≤ 2 mA) Input current at 24 V DC: typ. 3.5 mA For "1" signal: > 0.5 mA Input delay (typ.) For "0" → "1": 50 μs For "1" → "0": 150 μs protected against polarity reversal
	5	M2	Reference potential for digital inputs DI 0 to DI 3
	6	GND	Ground reference for the electronics
	7	DI/DO 8	As input:
	8	DI/DO 9	Voltage: -3 ... +30 V DC
	9	GND	Electrical isolation: no Reference potential: M
	10	DI/DO 10	Input characteristic acc. to IEC 61131-2, type 1
	11	DI/DO 11	Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V (at ≤ 2 mA) Input current at 24 V DC: typ. 3.5 mA For "1" signal: > 0.5 mA Input delay (typ.): For "0" → "1": 5 μs For "1" → "0": 50 μs DI/DO 8, 9, 10 and 11 are fast inputs ²⁾
	12	GND	As output: Voltage: 24 V DC Max. load current per output: 500 mA Output delay (typ. / max.) ³⁾ : For "0" → "1": 150 μs / 400 μs For "1" → "0": 75 μs / 100 μs Short-circuit, ground fault, overload proof Automatic switch on again after overload trip Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W

Type: Spring-loaded terminal 1 (Page 384)

Max. cross-section that can be connected: 1.5 mm² (AWG 16)

	Terminal	Designation ¹⁾	Technical data
--	----------	---------------------------	----------------

- 1) DI: Digital input; DI/DO: Bidirectional digital input/output
- 2) The rapid inputs can be used as probe inputs or as inputs for the external zero mark
- 3) Data for: $V_{cc} = 24\text{ V}$; load $48\ \Omega$; high ("1") = 90% V_{out} ; low ("0") = 10% V_{out}

The maximum cable length that can be connected is 30 m.

Note

An open input is interpreted as "low".

Terminal M2 must be connected so that the digital inputs (DI0 ... DI3) can be used. This is achieved through one of the following measures:

- Provide the ground reference of the digital inputs.
- A jumper to terminal M (this removes the electrical isolation for these digital inputs).

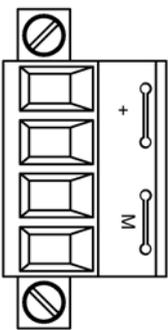
Note

A 24 V supply voltage must be connected to terminal X124 for the digital outputs to be used.

If momentary interruptions in the voltage occur in the 24 V supply, the digital outputs are deactivated until the interruption has been rectified.

8.4.2.9 X124 Electronics power supply

Table 8- 31 X124 Electronics power supply

	Terminal	Designation	Technical data
	+	Electronics power supply	Voltage: 24 V DC (20.4 ... 28.8 V) Current consumption: Max. 1.0 A (without DRIVE-CLiQ or digital outputs) Max. current via jumper in connector: 20 A (15 A according to UL/CSA)
	+	Electronics power supply	
	M	Electronics ground	
	M	Electronics ground	
Type: Screw-type terminal 2 (Page 384) Max. cross-section that can be connected: 2.5 mm ² (AWG 14)			

The screw terminal must be tightly screwed using a flat-bladed screwdriver.

The maximum cable length that can be connected is 30 m.

If the 24 V supply is not connected, the digital outputs of the following interfaces cannot be used:

- X121 (DO8 to DO11)
- X131 (DO12 to DO15)

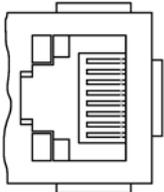
Note

The two "+" and/or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

The current consumption increases by the value for the DRIVE-CLiQ participant and digital outputs.

8.4.2.10 X127 LAN (Ethernet)

Table 8- 32 X127 LAN (Ethernet)

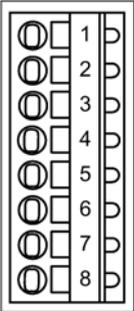
	Pin	Signal name	Technical data
	1	TXP	Ethernet transmit data +
	2	TXN	Ethernet transmit data -
	3	RXP	Ethernet receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Ethernet receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
Connector type	RJ45 socket		

Note

The Ethernet interface supports Auto MDI(X). It is therefore possible to use both crossed and uncrossed cables to connect the devices.

8.4.2.11 X130 digital input (fail safe) digital output

Table 8- 33 X130 Digital Input / Failsafe Digital Output

	Terminal	Designation ¹⁾	Technical data	
	1	DI 22+	Voltage: -3 ... +30 V DC Electrical isolation: Yes Reference potential: M2 Input characteristic acc. to IEC 61131-2, type 1 Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V (at ≤ 2 mA) Input current at 24 V DC: typ. 3.5 mA For "1" signal: > 0.5 mA Input delay (typ.): For "0" → "1": 50 µs For "1" → "0": 150 µs protected against polarity reversal	
	2	DI 22-		
	3	M2	Reference potential for digital inputs DI 0 to DI 3	
	4	GND	Ground reference for the electronics	
	5	M1	Reference potential for DI 16, DI 18, DI 20 and DO 16	
	6	24 V1	Power supply for DO 16	
	7	DO 16+	F-DO 0 ²⁾	Voltage: 24 V DC Max. Load current per output: 500 mA Output delay (typ./max.): For "0" → "1": 150 µs / 400 µs For "1" → "0": 75 µs / 100 µs Short-circuit, ground fault, overload proof Automatic switch on again after overload trip
	8	DO 16-		
Type: Spring-loaded terminal 1 (Page 384) Max. cross-section that can be connected: 1.5 mm ² (AWG 16)				

1) DI: Digital input/DO: Digital output

2) F-DO: Fail-safe digital output

The maximum cable length that can be connected is 30 m.

Fail-safe digital output

The F-DO consists of a high-side switch and a low-side switch.

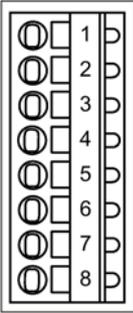
For applications without the safety function, the high-side switch may be used as an additional digital output. The low side switch is not available.

Note

If the 24 V supply is briefly interrupted, the digital output is deactivated until the interruption has been rectified.

8.4.2.12 X131 digital inputs/outputs and analog input

Table 8- 34 X131 bidirectional digital inputs/outputs and analog input

	Terminal	Designation ¹⁾	Technical data
	1	DI/DO 12	As input: Voltage: -3 ... +30 V DC Electrical isolation: no Reference potential: M Input characteristic acc. to IEC 61132-2, type 1 Input voltage (including ripple) "1" signal: 15 ... 30 V "0" signal: -3 ... +5 V (at ≤ 2 mA) Input current: at 24 V DC: typ. 3.5 mA For "1" signal: > 0.5 mA Input delay (typ.): For "0" → "1": 5 μs For "1" → "0": 50 μs DI/DO 12, 13, 14 and 15 are fast inputs ²⁾ As output: Voltage: 24 V DC Max. load current per output: 500 mA Output delay (typ. / max.) ³⁾ : For "0" → "1": 150 μs / 400 μs For "1" → "0": 75 μs / 100 μs Short-circuit, ground fault, overload proof Automatic switch on again after overload trip Switching frequency: For resistive load: Max. 100 Hz For inductive load: Max. 0.5 Hz For lamp load: Max. 10 Hz Maximum lamp load: 5 W
	2	DI/DO 13	
	3	GND	
	4	DI/DO 14	
	5	DI/DO 15	
	6	GND	Electronics ground
	7	AI 0+	The analog input can be switched between a current or voltage input using DIP switch S5. Common mode range: ±12 V As voltage input: -10 ... +10 V; R _i > 100 kΩ Resolution: 12-bit + sign (with respect to the maximum range that can be resolved -11 V ... 11 V) As current input: -20 ... 20 mA; R _i = 250 Ω Resolution: 11 bit + sign (referred to -22 ... 22 mA) Max. range that can be resolved: -44 ... 44 mA
	8	AI 0-	
Type: Spring-loaded terminal 1 (Page 384) Max. cross-section that can be connected: 1.5 mm ² (AWG 16)			

1) DI/DO: bidirectional digital input/output; AI: Analog input

2) The rapid inputs can be used as probe inputs or as inputs for the external zero mark.

3) Data for: V_{cc} = 24 V; load 48 Ω; high ("1") = 90% V_{out}; low ("0") = 10% V_{out}

The maximum cable length that can be connected is 30 m.

Note

Permissible voltage values at the analog input

The common-mode range must not be violated in order to avoid incorrect results of the analog-digital conversion. This means that the analog differential voltage signals can have a maximum offset voltage of +/- 15 V with respect to the reference potential.

Note

A 24 V supply must be connected to terminal X124 for the digital outputs to be used.

If momentary interruptions in the voltage occur in the 24 V supply, the digital outputs are deactivated until the interruption has been rectified.

8.4.2.13 Measuring sockets

Table 8- 35 Measuring sockets T0, T1, T2

	Socket	Function	Technical data
	T0	Measuring socket 0	Voltage: 0 ... V Resolution: 8 bits Load current: max. 3 mA Continued-short-circuit-proof The reference potential is terminal M
	T1	Measuring socket 1	
	T2	Measuring socket 2	
	GND	Ground	

The measuring sockets are only suitable for multiple-spring wire plugs with a diameter of 2 mm.

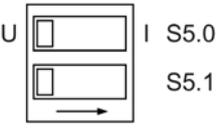
Note

Measuring sockets support commissioning and diagnosis. It must not be connected for normal operation.

8.4.2.14 S5 DIP switch

DIP switch S5 is used to switch the analog input between voltage input and current input. It is located under the blanking cover (see CU310-2 PN Interface Overview (Page 230).)

Table 8- 36 DIP switch S5 - switchover between voltage/current

	Switch	Function
	S5.0	Switchover between voltage (U) / current (I)
	S5.1	Not assigned

8.4.2.15 DIAG button

The DIAG pushbutton is reserved for service functions.

8.4.2.16 RESET button

Pressing the RESET button restarts the CU310-2 DP after expiry of a preset time. A data backup is run at the same time. This means that all the settings are retained.

8.4.2.17 Memory card

Inserting the memory card

Use only memory cards manufactured by Siemens to run the CU310-2 DP.

Insert the memory card into the CU310-2 DP so that the arrow on the card's label (on the left, next to the word Siemens) points to the arrow on the device.



Figure 8-12 CU310-2 DP Inserting the memory card

The memory card in a faulty CU310-2 DP

If you are returning a faulty CU310-2 DP to Siemens, remove the memory card and keep it in a safe place.

This ensures that all your saved data (firmware, licenses, parameters) will be available to you immediately again to commission a replacement unit.

8.4.3 Connection examples

CU310-2 DP without safety function

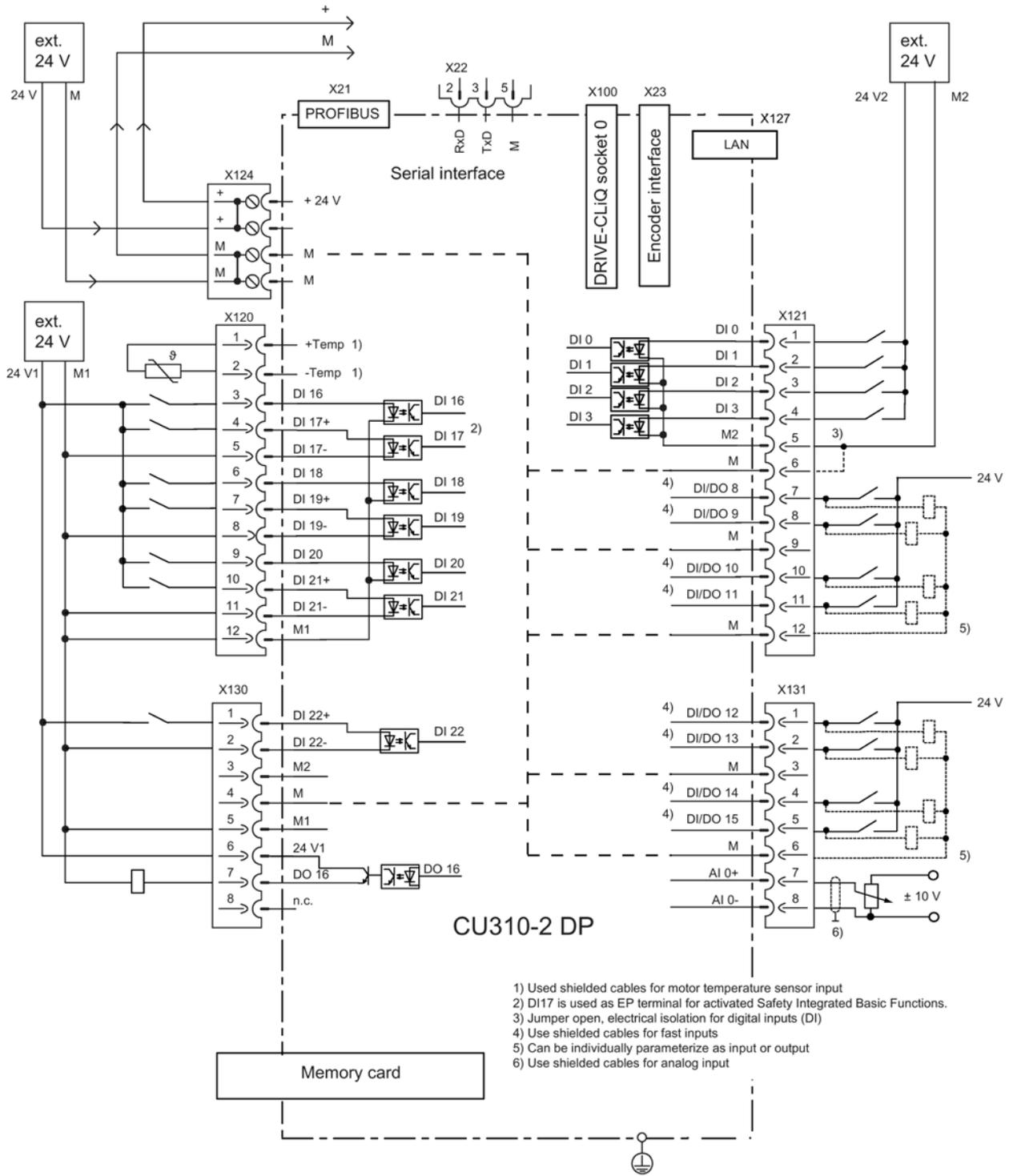


Figure 8-13 Connection example, CU310-2 DP without safety function

CU310-2 DP with safety function

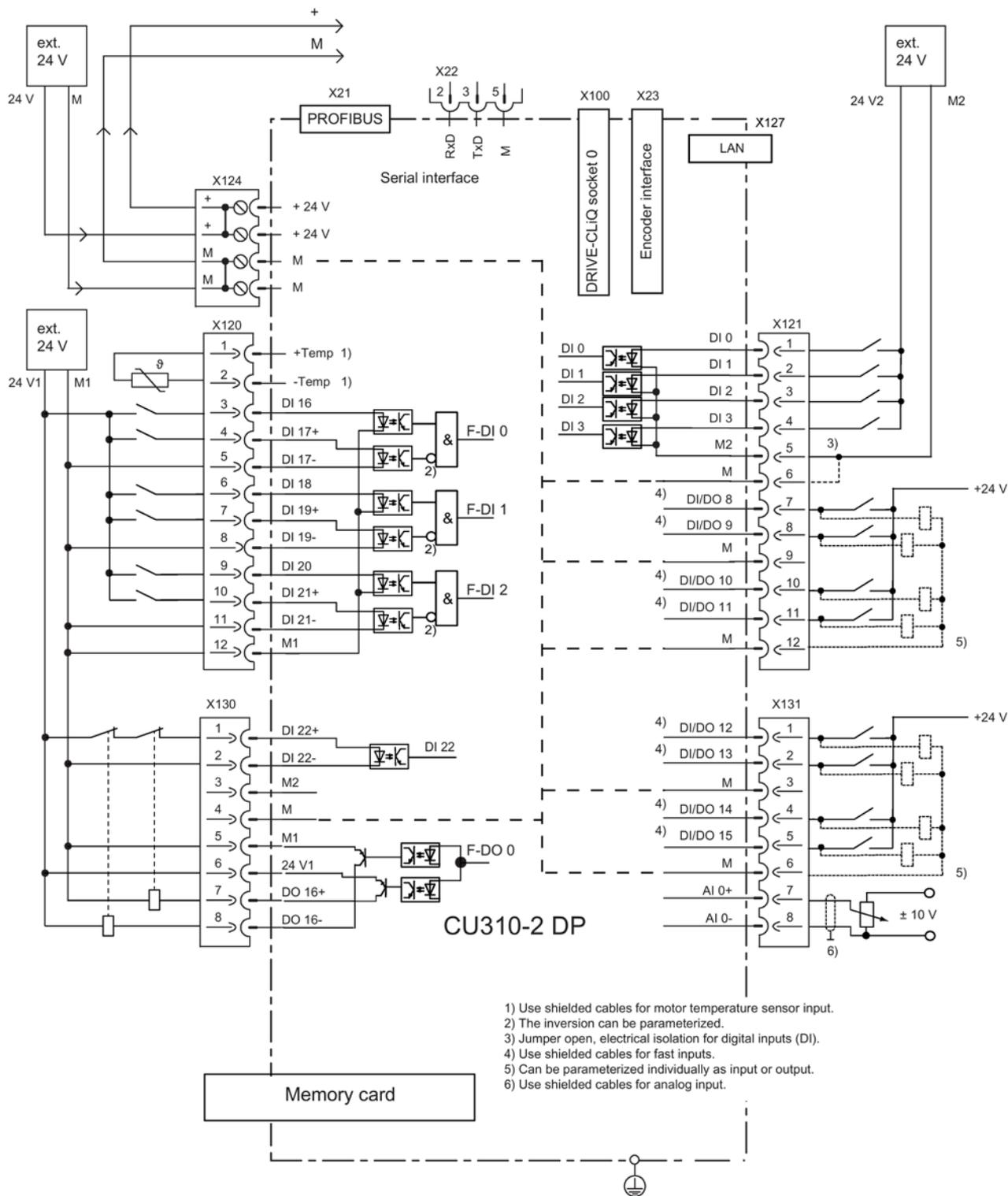


Figure 8-14 Connection example, CU310-2 DP with safety function

8.4.4 Meaning of the LEDs

8.4.4.1 Function of the LEDs

There are 4 LEDs on the front panel of the CU310-2 DP housing (see CU310-2 DP interface overview (Page 252).)

Table 8- 37 LEDs

RDY	Ready
COM	Status of the fieldbus communication
OUT>5V	Encoder current supply > 5 V (TTL/HTL)
MOD	Operating mode (reserved)

The various LEDs are switched on and off as the control unit is powered up (depending on the phase the system is currently in). When switched on, the color of the LEDs shows the status of the corresponding power-up phase (see LED display during power up (Page 271))

In the event of a fault, power up will be ended in the corresponding phase. The LEDs that are switched on retain their color at this particular instant in time, so that the fault can be determined based on the combination of LEDs that are switched on (bright) and switched off (dark).

All the LEDs go out briefly if the CU310-2 DP has powered up without error. The system is ready for operation when the LED "RDY" is permanently green.

All the LEDs are controlled by the software loaded during operation (see Behavior of the LEDs in the operating state (Page 272)).

8.4.4.2 Behavior of the LEDs during booting

Table 8- 38 Load software

LED				State	Comment
RDY	COM	OUT > 5V	MOD		
Orange	Orange	Orange	Orange	POWER ON	All LEDs light up for approx. 1 s
Red	Red	Off	Off	Hardware reset	After pressing the RESET button the LEDs light up for approx. 1 s
Red	Red	Off	Off	BIOS loaded	-
Red Flashing light 2 Hz	Red	Off	Off	BIOS error	Fault occurred while loading the BIOS
Red Flashing light 2 Hz	Red Flashing light 2 Hz	Off	Off	File error	Memory card not inserted or faulty Software on memory card not present or corrupted

Table 8- 39 Firmware

LED				State	Comment
RDY	COM	OUT > 5V	MOD		
Red	Orange	Off	Off	Firmware loading	COM-LED flashing without specific flashing frequency
Red	Off	Off	Off	Firmware loaded	-
Off	Red	Off	Off	Firmware check (no CRC error)	-
Red Flashing light 0.5 Hz	Red Flashing light 0.5 Hz	Off	Off	Firmware check (CRC error)	CRC is incorrect
Orange	Off	Off	Off	Firmware initialization	-

8.4.4.3 Behavior of the LEDs in the operating state

Table 8- 40 Description of the LEDs during operation of the CU310-2 DP

LED	Color	State	Description / cause	Remedy
RDY (READY)	-	OFF	The electronics power supply is missing or outside the permissible tolerance range.	Check the power supply
	Green	Continuous light	The unit is ready for operation. Cyclic DRIVE-CLiQ communication is in progress.	-
		Flashing light 0.5 Hz	Commissioning/reset	-
		Flashing light 2 Hz	Writing to the memory card.	-
	Red	Flashing light 2 Hz	General fault	Check parameter assignment/configuration
	Red/green	Flashing light 0.5 Hz	The control unit is ready for operation, but there are no software licenses.	Install the missing licenses.
	Orange	Flashing light 0.5 Hz	Updating the firmware of the DRIVE-CLiQ components.	-
		Flashing light 2 Hz	DRIVE-CLiQ component firmware update completed. Waiting for POWER ON of the corresponding components.	Switch on the component.
Green/orange or red/orange	Flashing light 2 Hz	Component identification using LED is activated (see SINAMICS S120/S150 List Manual). Remark: Both options depend on the status of the LED when activating.	-	

LED	Color	State	Description / cause	Remedy
COM	-	OFF	Cyclic communication is not (yet) running. Note: The PROFIdrive is ready for communication when the Control Unit is ready for operation (see LED: RDY).	-
	Green	Continuous light	Cyclic communication is taking place.	-
		Flashing light 0.5 Hz	Cyclic communication is not yet fully up and running. Possible causes: - the controller is not transmitting any setpoints. - in the isochronous mode, the controller is not sending a GC (Global Control) or it is sending a defective GC	-
	Red	Flashing light 0.5 Hz	The PROFIBUS master is sending a faulty parameter assignment or the configuration file is corrupted.	Modify the configuration between master/controller and control unit.
Flashing light 2 Hz		Cyclic bus communication has been interrupted or could not be established.	Rectify the fault in bus communication.	
MOD	-	OFF	-	-
OUT > 5 V	-	OFF	-	-
	Orange	Continuous light	The voltage of the electronics power supply for the measuring system is 24 V. ¹⁾	

¹⁾ Make sure that the encoder connected is designed for a 24 V supply. Connecting a 5 V encoder to a 24 V supply can result in destruction of the encoder electronics.

8.4.5 Dimension drawing

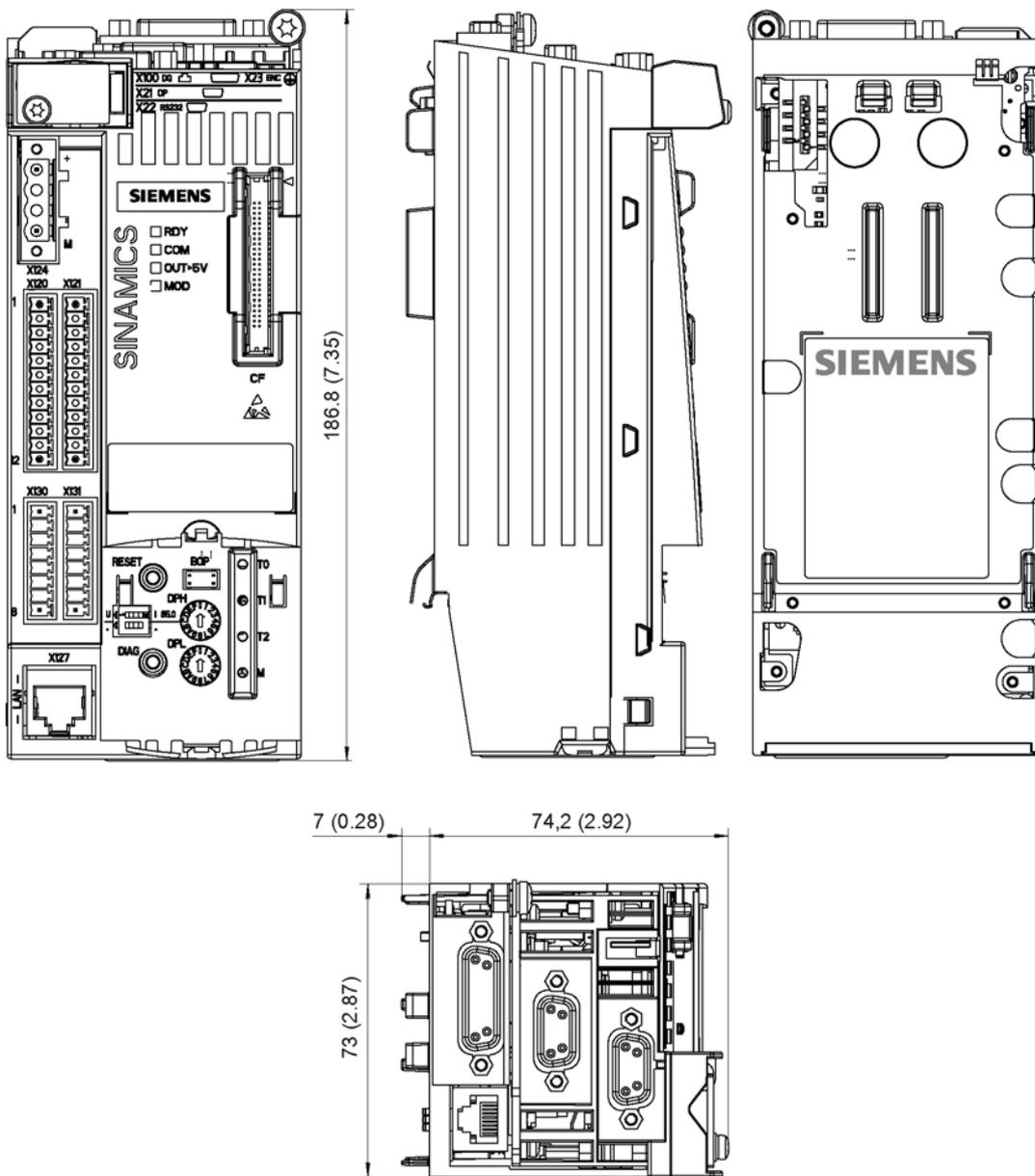


Figure 8-15 Dimension drawing, Control Unit CU310-2 DP, all data in mm (inches)

8.4.6 Technical data

Table 8- 41 Technical data of the CU310-2 DP

6SL3040-1LA00-OAA0	Unit	Value
Ambient temperature in operation	°C	0 ... 60
Electronics power supply		
Voltage	V _{DC}	24 DC (20.4 ... 28.8)
Current (without DRIVE-CLiQ and digital outputs)	A _{DC}	0.8
Power loss	W	< 20
Maximum DRIVE-CLiQ cable length	m	100
Protective conductor/ground connection	At the housing with screw M4/3 Nm (26.6 lbf in)	
Response time	The response time of digital inputs/outputs depends on the evaluation. ¹⁾	
Weight	kg	0.95

1) You will find information on this topic in the SINAMICS S120/S150 List Manual, Chapter "Function block diagrams".

8.5 Control Unit Adapter CUA31

8.5.1 Description

The CUA31 Control Unit Adapter is used to connect a Power Module blocksize to an existing DC/AC group with a higher-level control module, e.g. a CU320-2. Since the closed-loop control is realized externally, for operation, a SINAMICS, SIMOTION, or SINUMERIK closed-loop control is always required for several axes.

The Control Unit Adapter CUA31 has the following interfaces (ports):

Table 8- 42 Interface overview of the CUA31

Type	Number
DRIVE-CLiQ interface	3
EP terminal/temperature sensor	1
Power Module Interface (PM-IF)	1
24 V electronics power supply	1

8.5.2 Interface description

8.5.2.1 Overview

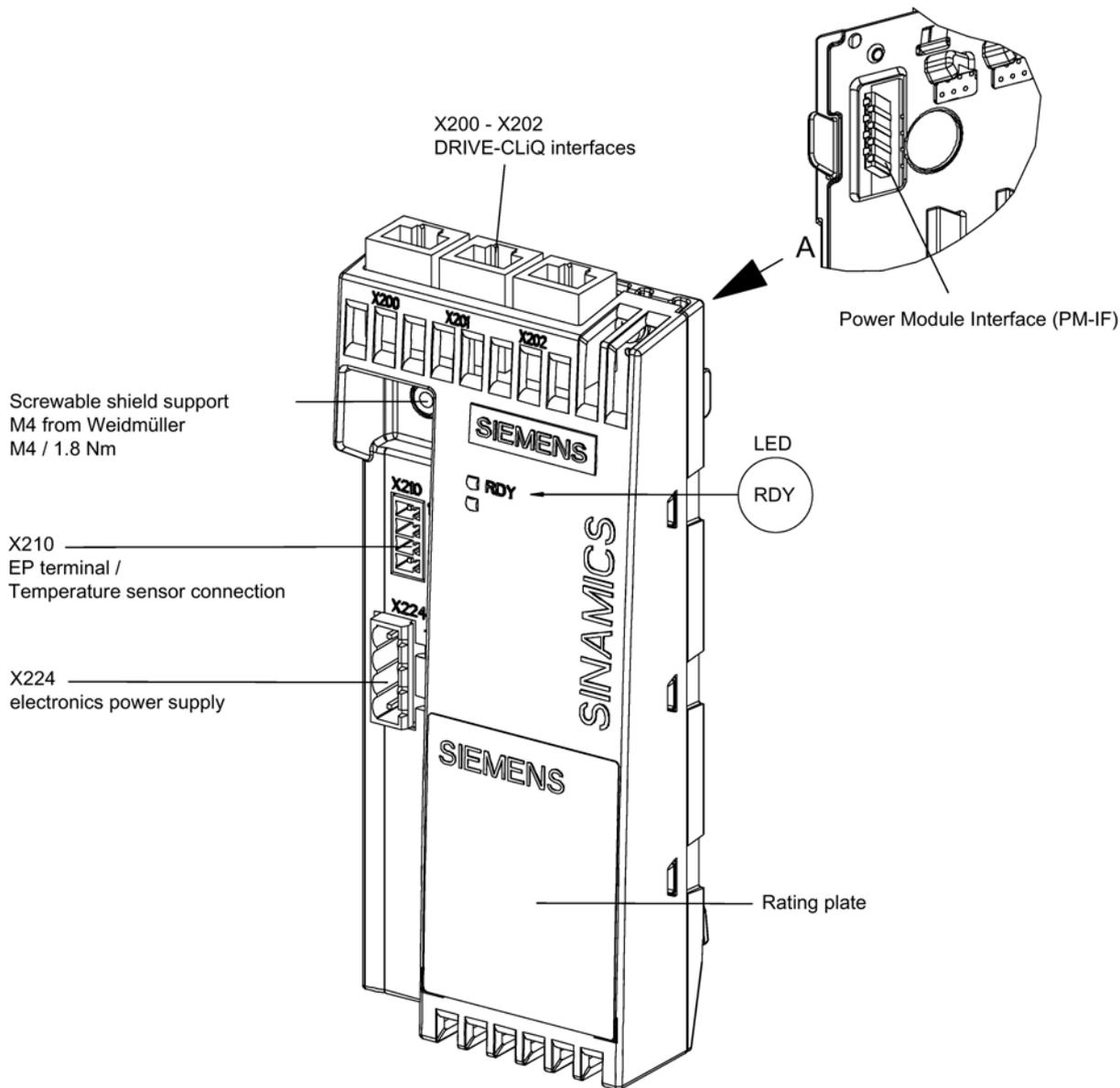
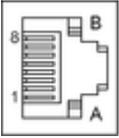


Figure 8-16 Interface overview of the CUA31

8.5.2.2 X200-X202 DRIVE-CLiQ interfaces

Table 8- 43 X200-X202 DRIVE-CLiQ interfaces

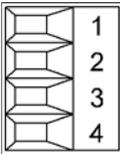
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking covers (50 pieces) Article No.: 6SL3066-4CA00-0AA0

8.5.2.3 X210 EP terminal / temperature sensor

Table 8- 44 X210 EP terminal / temperature sensor input

	Terminal	Function	Technical data
	1	+ Temp ¹⁾	Temperature sensor KTY84-130 / Pt1000 / PTC / bimetallic switch with NC contact
	2	- Temp ¹⁾	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 VDC (20.4 ... 28.8 V)
	4	EP M1 (enable pulses)	Electrical isolation: Yes Input current: typ. 4 mA at 24 V DC
Type: Screw terminal 1 (Page 384) Max. connectable cross-section 1.5 mm ² (AWG 16)			

¹⁾ Further information regarding the temperature sensor may be found in the SINAMICS S120 Commissioning Manual, Section "Temperature sensors for SINAMICS components."

Temperature sensor input

The temperature sensor is required for motors where the temperature value is not transmitted via DRIVE-CLiQ.

NOTICE

Damage to motor due to incorrectly connected KTY temperature sensor

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

- Connect a KTY temperature sensor with the correct polarity.

The maximum length of the temperature sensor cable is 300 m. The cables must be shielded. For cable lengths > 100 m, cables with a cross-section of $\geq 1 \text{ mm}^2$ must be used.

"Safe Torque Off" function

If the "Safe Torque Off" function is selected, a 24 V DC voltage must be connected to terminals 3 and 4. Upon removal, pulse inhibit is activated.

Note

Function of the EP terminals

The function of the EP terminals for pulse inhibit is only available if the "Safety Integrated Basic Functions via onboard terminals" is enabled in the software.



⚠ WARNING

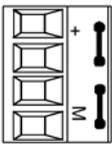
Electric shock in the event of voltage flashovers at the temperature sensor

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that comply with the specifications relating to protective separation.
- If safe electrical separation cannot be guaranteed (e.g. for linear motors or third-party motors), use a SME120 or SME125 Sensor Module External or the TM120 Terminal Module.

8.5.2.4 X224 electronics power supply

Table 8- 45 X224 electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply	Voltage: 24 VDC (20.4 ... 28.8 VDC)
	+	Electronics power supply	Current consumption: max. 0.8 A (without DRIVE-CLiQ)
	GND	Electronics ground	Max. current via jumper in connector: 20 A (15 A according to UL/CSA)
	GND	Electronics ground	
Type: Screw-type terminal 2 (Page 384) Max. cross-section that can be connected: 2.5 mm ² (AWG 14)			

The maximum cable length that can be connected is 30 m.

Note

The two "+" and/or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

The current consumption increases by the value for the DRIVE-CLiQ node.

8.5.3 Connection example

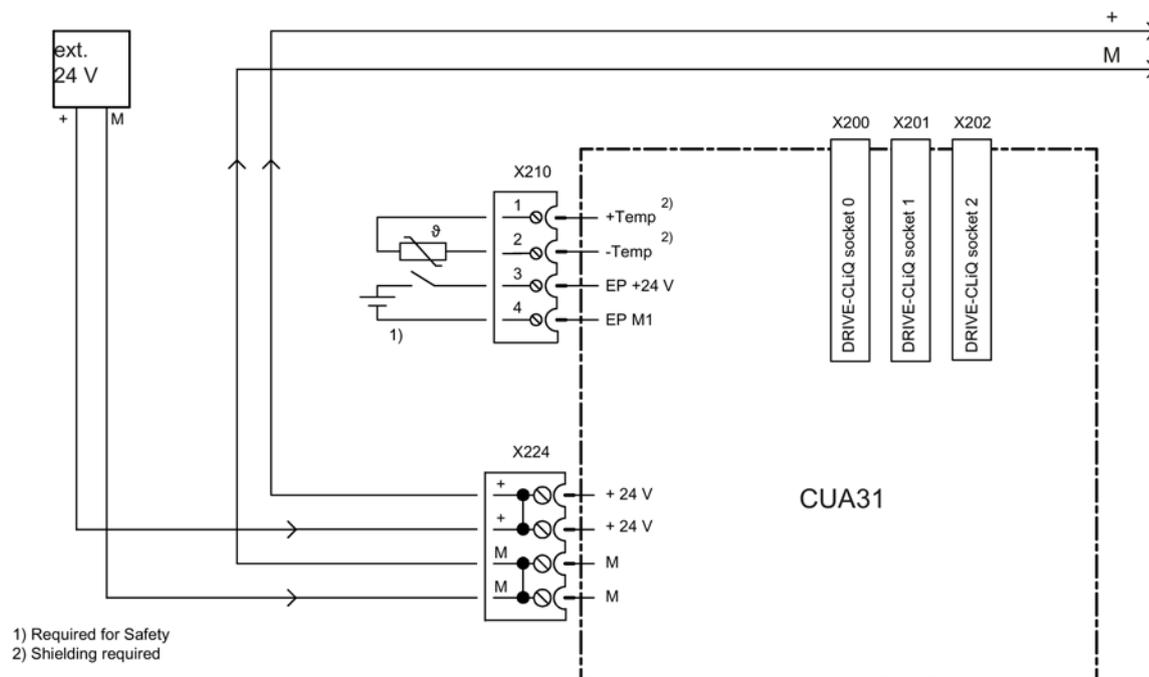


Figure 8-17 Connection example, CUA31

8.5.4 Meaning of the LEDs

Table 8- 46 Meaning of the LEDs at the Control Unit Adapter 31

LED	Color	Status	Description
RDY (READY)	Red	continuous light	At least one fault is present in this component.
	Green	continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.

Cause and rectification of faults

Information about the cause and rectification of faults can be found in the SINAMICS S120 Commissioning Manual.

8.5.5 Dimension drawing

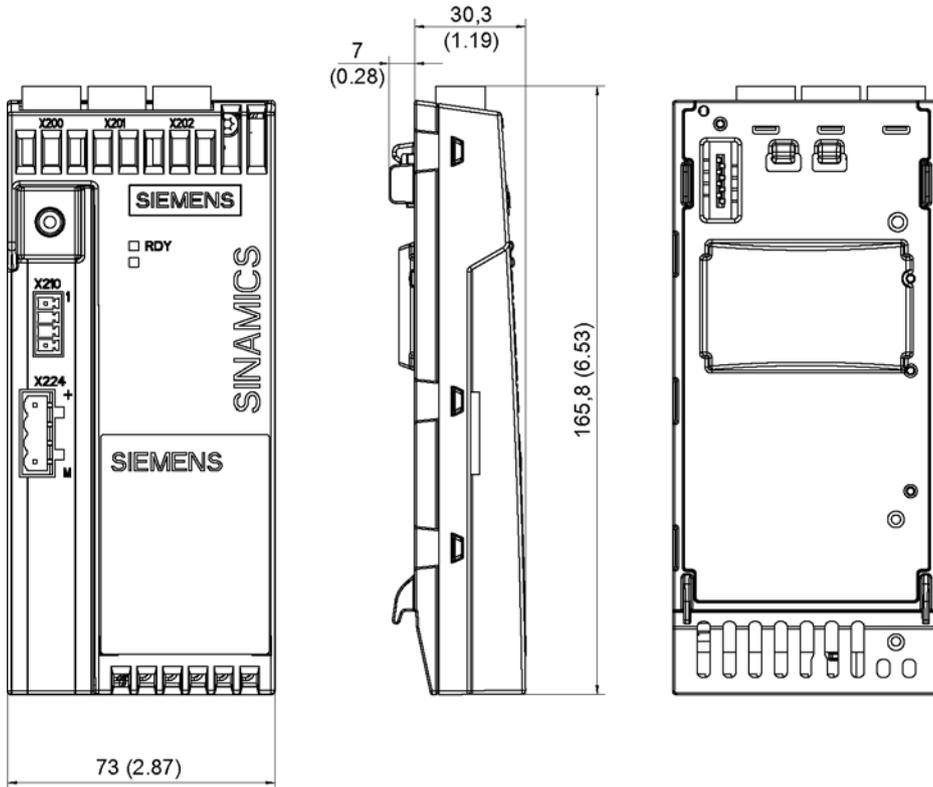


Figure 8-18 Dimension drawing of Control Unit Adapter CUA31, all data in mm and (inches)

8.5.6 Technical data

Table 8- 47 Technical data CUA31

6SL3040-0PA00-0AA0 / 6SL3040-0PA00-0AA1	Unit	Value
Ambient temperature in operation	°C	0 ... 55
Electronics power supply		
Voltage	V _{DC}	24 V DC (20.4 ... 28.8)
Current (without DRIVE-CLiQ)	A _{DC}	0.1
Power loss	W	2.4
Maximum DRIVE-CLiQ cable length		
CUA31 with article number 6SL3040-0PA00-0AA0	m	50
CUA31 from article number 6SL3040-0PA00-0AA1	m	100
Weight	kg	0.31

8.6 Control Unit Adapter CUA32

8.6.1 Description

The Control Unit Adapter CUA32 is used to connect a Power Module blocksize to an existing DC/AC group with a higher-level control module, e.g. a CU320-2. Since the closed-loop control is realized externally, for operation, a SINAMICS, SIMOTION, or SINUMERIK closed-loop control is always required for several axes.

The CUA32 offers additional encoder interface (HTL / TTL / SSI).

The Control Unit Adapter CUA32 has the following interfaces (ports):

Table 8- 48 Interface overview of the CUA32

Type	Number
DRIVE-CLiQ interface	3
EP terminal/temperature sensor	1
Power Module Interface (PM-IF)	1
24 V electronics power supply	1
Encoder interface (HTL/TTL/SSI ⁽¹⁾)	1

¹ Only SSI encoders without incremental tracks can be operated on the CUA32.

8.6.2 Interface description

8.6.2.1 Overview

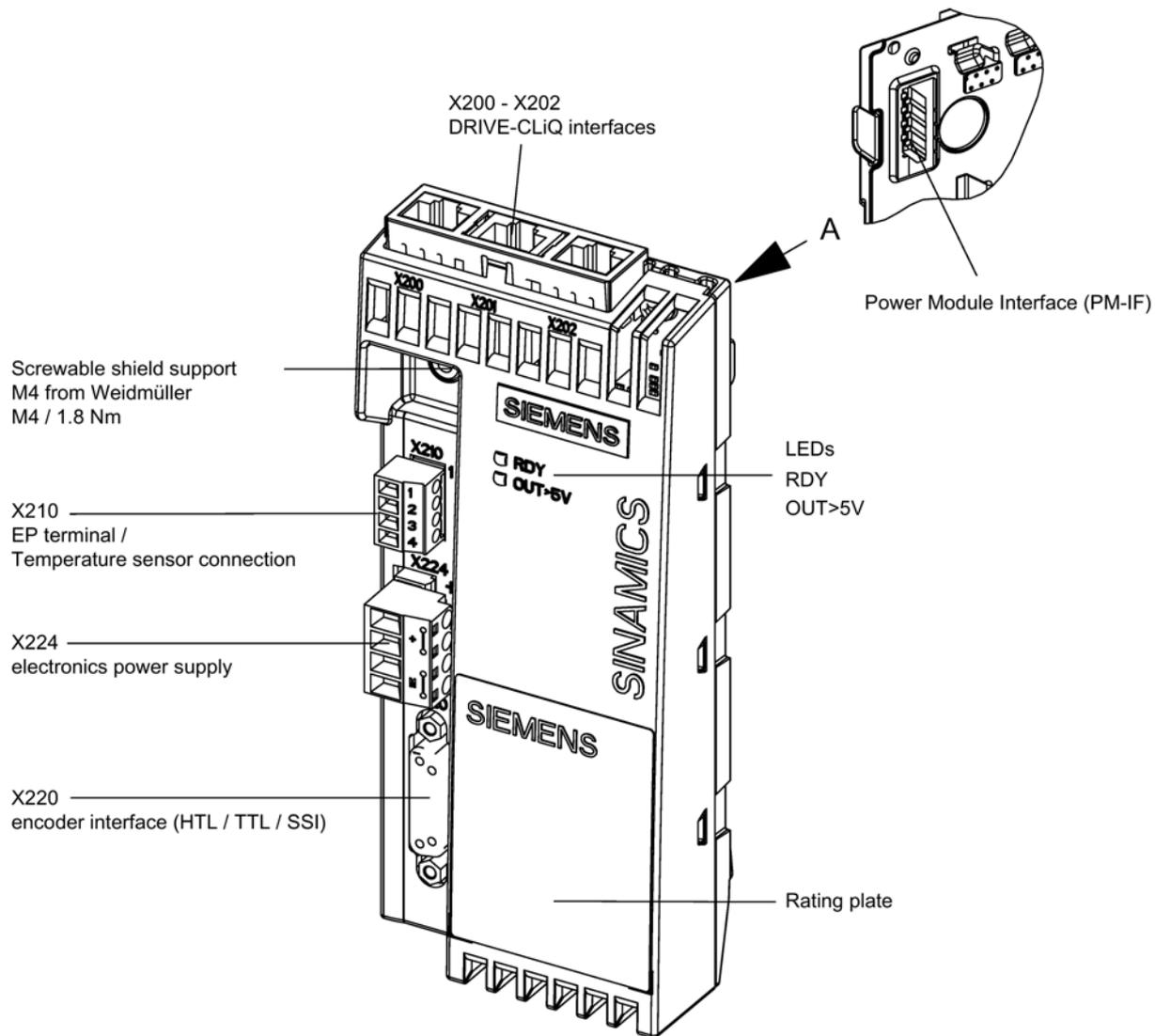
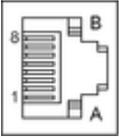


Figure 8-19 Interface overview CUA32

8.6.2.2 X200-X202 DRIVE-CLiQ interfaces

Table 8- 49 X200-X202 DRIVE-CLiQ interfaces

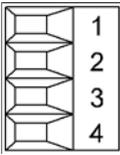
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	+ (24 V)	Power supply
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

The blanking covers for the DRIVE-CLiQ interfaces are included in the scope of delivery.

Blanking covers (50 pieces) Article No.: 6SL3066-4CA00-0AA0

8.6.2.3 X210 EP terminal / temperature sensor

Table 8- 50 X210 EP terminal / temperature sensor input

	Terminal	Function	Technical data
	1	+ Temp ¹⁾	Temperature sensor KTY84-130 / Pt1000 / PTC / bimetallic switch with NC contact
	2	- Temp ¹⁾	
	3	EP +24 V (Enable Pulses)	Supply voltage: 24 VDC (20.4 ... 28.8 V)
	4	EP M1 (enable pulses)	Electrical isolation: Yes Input current: typ. 4 mA at 24 V DC
Type: Screw terminal 1 (Page 384) Max. connectable cross-section 1.5 mm ² (AWG 16)			

¹⁾ Further information regarding the temperature sensor may be found in the SINAMICS S120 Commissioning Manual, Section "Temperature sensors for SINAMICS components."

Temperature sensor input

The temperature sensor is required for motors where the temperature value is not transmitted via DRIVE-CLiQ.

NOTICE

Damage to motor due to incorrectly connected KTY temperature sensor

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

- Connect a KTY temperature sensor with the correct polarity.

The maximum length of the temperature sensor cable is 300 m. The cables must be shielded. For cable lengths > 100 m, cables with a cross-section of $\geq 1 \text{ mm}^2$ must be used.

"Safe Torque Off" function

If the "Safe Torque Off" function is selected, a 24 V DC voltage must be connected to terminals 3 and 4. Upon removal, pulse inhibit is activated.

Note

Function of the EP terminals

The function of the EP terminals for pulse inhibit is only available if the "Safety Integrated Basic Functions via onboard terminals" is enabled in the software.



⚠ WARNING

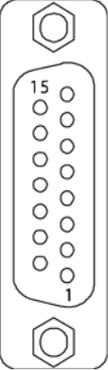
Electric shock in the event of voltage flashovers at the temperature sensor

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that comply with the specifications relating to protective separation.
- If safe electrical separation cannot be guaranteed (e.g. for linear motors or third-party motors), use a SME120 or SME125 Sensor Module External or the TM120 Terminal Module.

8.6.2.4 X220 HTL/TTL/SSI encoder interface

Table 8- 51 X220 HTL/TTL/SSI encoder interface

	Pin	Signal name	Technical data
	1	+Temp	KTY, Pt1000, PTC input or bimetallic switch with NC contact
	2	SSI_CLK	SSI clock, positive
	3	SSI_XCLK	SSI clock, negative
	4	P encoder 5 V / 24 V	Encoder power supply
	5	P encoder 5 V / 24 V	Encoder power supply
	6	P sense	Sense input encoder power supply
	7	M encoder (M)	Ground, encoder power supply
	8	-Temp	Ground for KTY, Pt1000, PTC or bimetallic switch with NC contact
	9	M sense	Ground sense input
	10	RP	R track positive
	11	RN	R track negative
	12	BN	B track negative
	13	BP	B track positive
	14	AN_SSI_XDAT	A track negative / SSI data negative
15	AP_SSI_DAT	A track positive / SSI data positive	
Connector type	15-pin sub D connector		

NOTICE**Damage to motor due to incorrectly connected KTY temperature sensor**

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

- Connect a KTY temperature sensor with the correct polarity.

Table 8- 52 Specification of measuring systems that can be connected

Parameter	Designation	Threshold	Min.	Type	Max.	Unit
High signal level (TTL bipolar at X220)	U_{Hdiff}	-	2	-	5	V
Low signal level (TTL bipolar at X220)	U_{Ldiff}	-	-5	-	-2	V
High signal level (HTL unipolar)	U_H	High	17	-	V_{CC}	V
		Low	10	-	V_{CC}	V
Low signal level (HTL unipolar)	U_L	High	0	-	7	V
		Low	0	-	2	V
High signal level (HTL bipolar)	U_{Hdiff}	-	3	-	V_{CC}	V

Parameter	Designation	Threshold	Min.	Type	Max.	Unit
Low signal level (HTL bipolar)	U_{Ldiff}	-	$-V_{CC}$	-	-3	V
High signal level (SSI bipolar at X220)	U_{Hdiff}	-	2	-	5	V
Low signal level (SSI bipolar at X220)	U_{Ldiff}	-	-5	-	-2	V
Signal frequency	f_s	-	-	-	500	kHz
Edge clearance	t_{min}	-	100	-	-	ns
Zero pulse (with $T_s = 1/f_s$)	Length	-	$\frac{1}{4} \cdot T_s$	-	$\frac{3}{4} \cdot T_s$	-
	Center of the pulse position	-	50	135	220	degrees

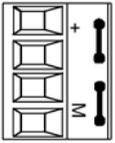
Note

We recommend that bipolar encoders are used.

When uni-polar encoders are used, the 15-pin sub D connector should be opened and the unused inverse signals (AN Pin14, BN Pin12 and RN Pin11) connected to ground (Pin7).

8.6.2.5 X224 electronics power supply

Table 8- 53 X224 electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply	Voltage: 24 VDC (20.4 ... 28.8 VDC) Current consumption: max. 0.8 A (without DRIVE-CLiQ and encoder)
	+	Electronics power supply	
	GND	Electronics ground	Max. current via jumper in connector: 20 A (15 A according to UL/CSA)
	GND	Electronics ground	
Type: Screw-type terminal 2 (Page 384) Max. cross-section that can be connected: 2.5 mm ² (AWG 14)			

The maximum cable length that can be connected is 30 m.

Note

The two "+" and/or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

The current consumption increases by the value for the DRIVE-CLiQ node and the encoder.

8.6.3 Connection example

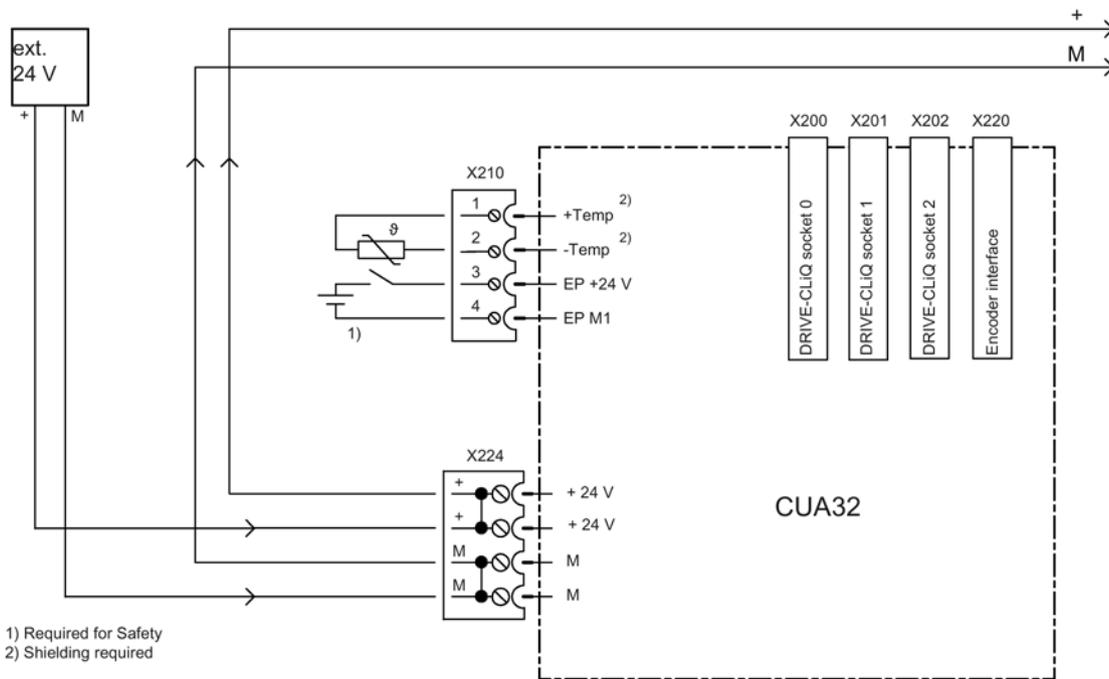


Figure 8-20 Connection example for CUA32

8.6.4 Meaning of the LEDs

Table 8- 54 Meaning of the LEDs on the Control Unit Adapter CUA32

LED	Color	Status	Description
RDY (READY)	Red	continuous light	At least one fault is present in this component.
	Green	continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.
OUT > 5V	-	Off	Electronics power supply is missing or outside permissible tolerance range. Power supply: ≤ 5 V.
	Orange	continuous light	Electronics power supply for measuring system available. Power supply: > 5 V. Remark You must ensure that the connected encoder can be operated with a 24 V power supply. If an encoder that is designed for a 5 V power supply is operated with a 24 V power supply, this can destroy the encoder electronics.

Cause and rectification of faults

Information about the cause and rectification of faults can be found in the SINAMICS S120 Commissioning Manual.

8.6.5 Dimension drawing

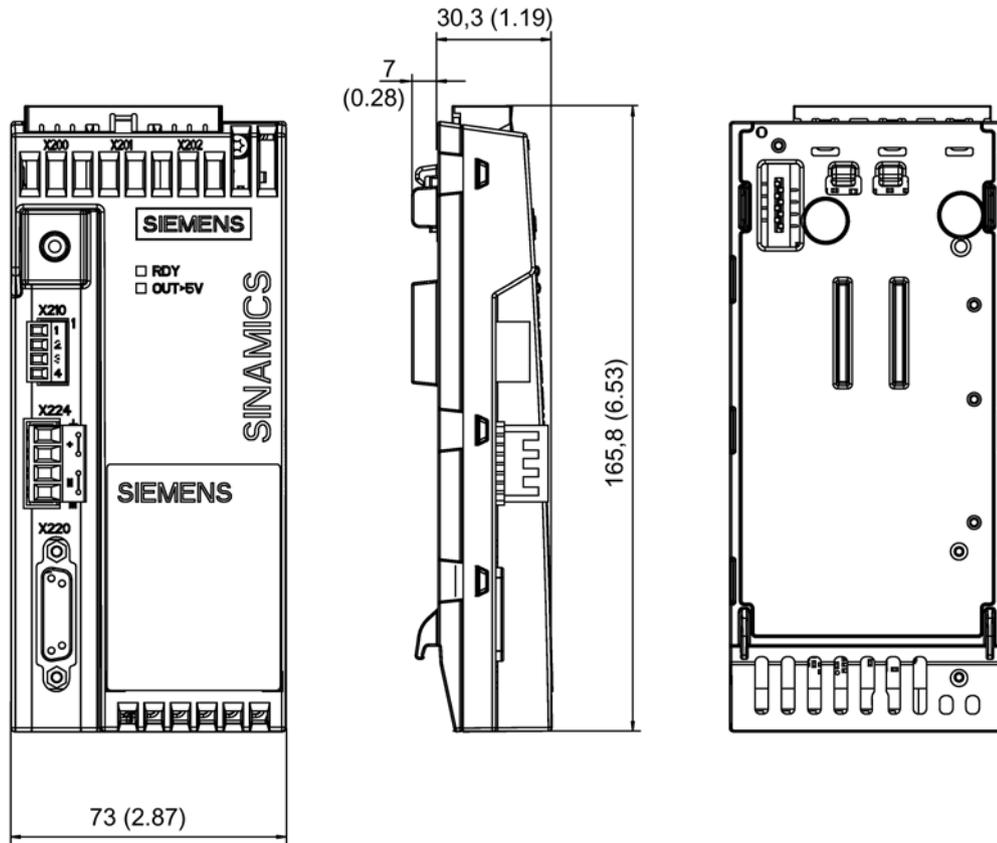


Figure 8-21 Dimension drawing of Control Unit Adapter CUA32, all data in mm and (inches)

8.6.6 Technical data

Table 8- 55 Technical data CUA32

6SL3040-0PA01-0AA0	Unit	Value
Ambient temperature in operation	°C	0 ... 55
Electronics power supply		
Voltage	V _{DC}	24 V DC (20.4 ... 28.8)
Current (without DRIVE-CLiQ and encoder)	A _{DC}	0.11
Maximum current consumption of encoder	mA	400
Power loss	W	2.6
Maximum DRIVE-CLiQ cable length	m	100
Weight	kg	0.34

8.7 Mounting Control Units and Control Unit Adapters

Power Modules Blocksize

Control Unit (CU310-2 PN/DP) and Control Unit Adapter (CUA31/CUA32) can be mounted onto Power Modules Blocksize of any frame size. Communication between the devices is realized via the PM-IF interface.

Mounting

1. Mount the Control Unit / the Control Unit Adapter on the PM ①.

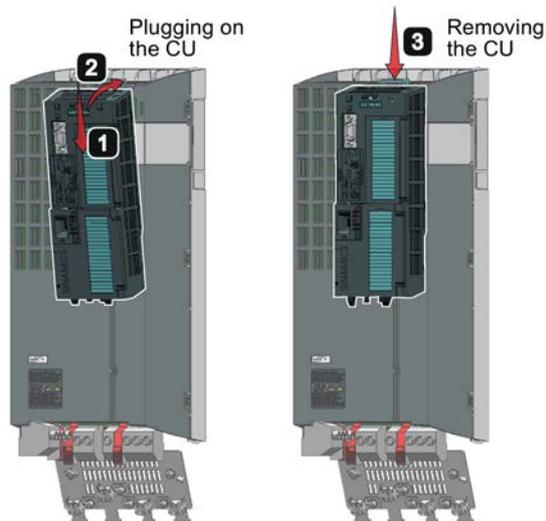


Figure 8-22 Mounting (left) and removal (right) of the Control Unit

2. Press the Control Unit / Control Unit Adapter back until it latches into the blue interlocking lug ②.

Removal

1. Press the blue locking latch downward ②.
2. Remove the Control Unit / Control Unit Adapter towards the front.

Power Module Chassis

1. Connect the DRIVE-CLiQ interfaces of Power Module Chassis and the Control Unit/Control Unit Adapter.
The DRIVE-CLiQ interface of the Power Module Chassis is located behind the mounting plate.
2. Mount the Control Unit/Control Unit Adapter on the mounting plate.

8.8 Basic Operator Panel BOP20

8.8.1 Description

The Basic Operator Panel BOP20 is a basic operator panel with six keys and a backlit display unit. The BOP20 can be inserted on the CU310-2 DP and CU310-2 PN SINAMICS Control Units and operated.

The BOP20 supports the following functions:

- Input of parameters and activation of functions
- Display of operating modes, parameters, alarms and faults

8.8.2 Interface description



Figure 8-23 Basic Operator Panel BOP20

Overview of displays and keys

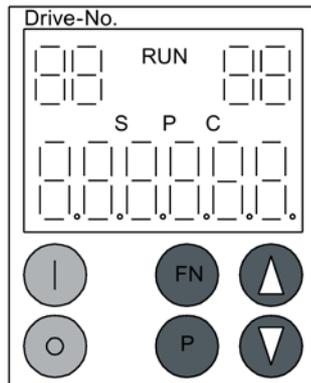


Figure 8-24 Overview of displays and keys

Table 8- 56 Displays

Display	Meaning
Top left 2 positions	The active drive object of the BOP is displayed here. The displays and key operations always refer to this drive object.
RUN	Is lit (bright) if the displayed drive is in the RUN state (in operation).
Top right 2 positions	The following is displayed in this field: <ul style="list-style-type: none"> • More than 6 digits: Characters that are present but cannot be seen (e.g. "r2" → 2 characters to the right are invisible, "L1" → 1 character to the left is invisible) • Faults: Selects/displays other drives with faults • Designation of BICO inputs (bi, ci) • Designation of BICO outputs (bo, co) Source object of a BICO interconnection to a drive object other than the active one.
S	Is (bright) if at least one parameter was changed and the value was not transferred into the non-volatile memory.
P	Is lit (bright) if, for a parameter, the value only becomes effective after pressing the P key.
C	Is light (bright) if at least one parameter was changed and the calculation for consistent data management has still not been initiated.
Below, 6 digit	Displays, e.g. parameters, indices, faults and alarms.

BOP20 keyboard

Table 8- 57 Assignment of the BOP20 keyboard

Key	Name	Meaning
	ON	Powering-up the drives for which the command "ON/OFF1", "OFF2" or "OFF3" should come from the BOP.
	OFF	Power-down the drives for which the "ON/OFF1," "OFF2," or "OFF3" commands should come from the BOP. Note: The effectiveness of these keys can be defined using the appropriate BICO parameterization (e.g. using these keys, it is possible to simultaneously control all of the axes that have been configured.) The structure of the BOP control word corresponds to the structure of the PROFIBUS control word.
	Functions	The meaning of these keys depends on the actual display. Note: The effectiveness of this key to acknowledge faults can be defined using the appropriate BICO parameterization.
	Parameter	The meaning of these keys depends on the actual display.
	Raise	The keys are dependent on the actual display and are used to raise or lower values.
	Lower	

8.8.3 Mounting

NOTICE

Damage when using the BOP

The interface for the BOP20 on the CU310-2 may be damaged when the BOP20 is used.

- Make sure that you insert and withdraw the BOP20 straight into/out of the CU310-2 and that it is not tilted up or down.

Mounting

The diagrams show how to mount the Basic Operator Panel BOP20 on a CU310-2.

		
<p>1. To remove the blanking cover, press the latching cams of the cover together simultaneously and pull the cover straight out.</p>	<p>2. Press the latching cams on the BOP20 together simultaneously and push the BOP20 straight into the housing of the CU310-2 until you hear it latch into position.</p>	<p>CU310-2 with mounted BOP20.</p>

Note

The BOP20 may be inserted or withdrawn while the Control Unit is operational.

Removal

1. Simultaneously press the latching cams on the BOP20.
2. Keep the latching cams pressed together and pull the BOP20 straight out.
3. Insert the blanking cover.

Display and operator controls of the BOP20

Additional information on the displays and operator controls of the BOP20 is available in the SINAMICS S120 Function Manual "Drive Functions".

Supplementary system components and encoder system integration

9

9.1 Sensor Modules

9.1.1 Safety instructions for Sensor Modules Cabinet-Mounted



! WARNING
Electric shock when disconnecting and connecting encoder cables during operation
When opening plug connections in operation, arcs can result in severe injury or death.
<ul style="list-style-type: none">• Disconnect or connect the encoder cables to Siemens motors, which are not expressly released for connecting and disconnecting during operation, in a deenergized condition only.• When using direct measuring systems (third-party encoders), ask the manufacturer whether hot-plugging is permitted.

NOTICE
Damage when connecting an impermissible number of encoder systems
If more than the maximum permissible number of encoder systems are connected to a Sensor Module, this will cause damage.
<ul style="list-style-type: none">• Only connect one encoder system per Sensor Module.

NOTICE
Damage caused by the use of incorrect DRIVE-CLiQ cables
The use of incorrect or not released DRIVE-CLiQ cables can cause damage or functional faults to devices or the system.
<ul style="list-style-type: none">• Only use suitable DRIVE-CLiQ cables that have been approved by Siemens for the respective application.

Note

Diminished level of interference immunity due to equalizing currents via the electronics ground

Ensure that there is no electrical connection between the encoder system housing and the signal cables, or the encoder system electronics. If this is not carefully observed, the system may not be able to reach the required interference immunity level. (There is then a danger of equalization currents flowing through the electronics ground.)

Note

Function equipotential bonding for distributed DRIVE-CLiQ nodes

Integrate all of the components that are connected via DRIVE-CLiQ into the function equipotential bonding concept. The connection should be preferably established by mounting on metallic bright machine and plant components that are connected with one another using an equipotential bonding conductor.

Alternatively, you can establish equipotential bonding using a conductor (min. 6 mm²), which as far as possible, is routed parallel to the DRIVE-CLiQ cable. This involves all distributed DRIVE-CLiQ nodes, for example, SMCxx.

Note

Functional faults caused by dirty DRIVE-CLiQ interfaces

Malfunctions can occur in the system through the use of polluted DRIVE-CLiQ interfaces.

- Close any unused DRIVE-CLiQ interfaces with the supplied cover plates.
-

9.1.2 Sensor Module Cabinet-Mounted SMC10

9.1.2.1 Description

The Sensor Module Cabinet-Mounted SMC10 is an expansion module for snapping on to a standard mounting rail acc. to EN 60715. It evaluates encoder signals and transmits the speed, actual position value, rotor position and, if necessary, the motor temperature via DRIVE-CLiQ to the Control Unit.

The SMC10 is used to evaluate sensor signals from resolvers.

9.1.2.2 Interface description

Overview

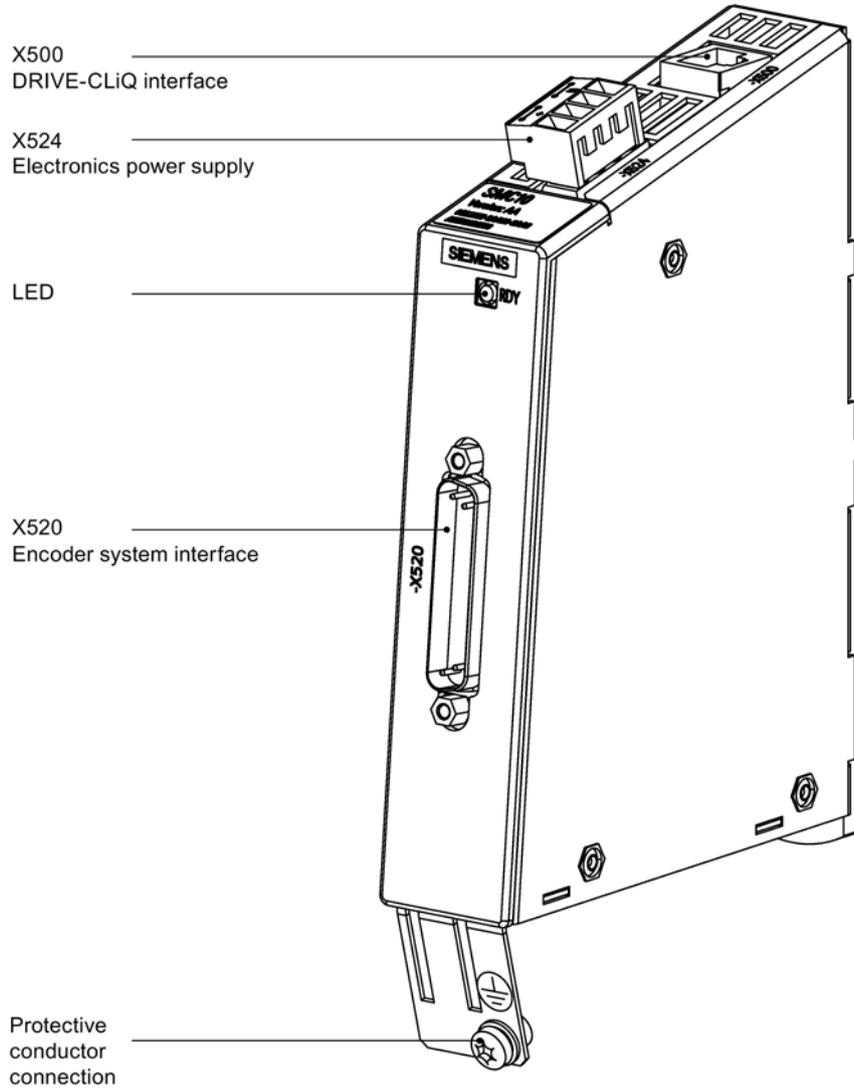
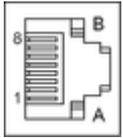


Figure 9-1 Interface overview for the SMC10

X500 DRIVE-CLiQ interface

Table 9- 1 X500: DRIVE-CLiQ interface

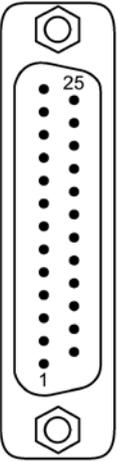
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	Reserved, do not use	-
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

Blanking covers (50 x) Article No.: 6SL3066-4CA00-0AA0

X520 encoder system interface

Table 9- 2 X520: Encoder system interface

	Pin	Signal name	Technical data
	1	Reserved, do not use	-
	2	Reserved, do not use	-
	3	S2	Resolver signal A (sin+)
	4	S4	Inverted resolver signal A (sin-)
	5	Ground	Ground (for internal shield)
	6	S1	Resolver signal B (cos+)
	7	S3	Inverted resolver signal B (cos-)
	8	Ground	Ground (for internal shield)
	9	R1	Resolver excitation positive
	10	Reserved, do not use	-
	11	R2	Resolver excitation negative
	12	Reserved, do not use	-
	13	+ Temp ¹⁾	KTY84-130 / Pt1000 / PTC temperature sensors
	14	Reserved, do not use	-
	15	Reserved, do not use	-
	16	Reserved, do not use	-
	17	Reserved, do not use	-
	18	Reserved, do not use	-
	19	Reserved, do not use	-
	20	Reserved, do not use	-
	21	Reserved, do not use	-
	22	Reserved, do not use	-
	23	Reserved, do not use	-
	24	Ground	Ground (for internal shield)
	25	- Temp ¹⁾	KTY84-130 / Pt1000 / PTC temperature sensors
Connector type:	25-pin SUB D connector		
Measuring current via temperature sensor connection: 2 mA			

¹⁾ Accuracy of the temperature measurement:

- KTY: ± 7 °C (including evaluation)
- Pt1000: ± 5 °C (Pt1000 tolerance class B according to EN 60751 including evaluation)
- PTC: ± 5 °C (including evaluation)

NOTICE**Damage to motor due to incorrectly connected KTY temperature sensor**

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

- Connect a KTY temperature sensor with the correct polarity.

Information for assigning parameters to the KTY temperature sensor can be found in the SINAMICS S120 Function Manual "Drive Functions" in the Chapter "Monitoring and protection functions/thermal motor protection".



⚠ WARNING
<p>Electric shock in the event of voltage flashovers at the temperature sensor</p> <p>Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.</p> <ul style="list-style-type: none"> • Use temperature sensors that comply with the specifications relating to protective separation. • If safe electrical separation cannot be guaranteed (e.g. for linear motors or third-party motors), use a SME120 or SME125 Sensor Module External or the TM120 Terminal Module.

X524 Electronics power supply

Table 9- 3 X524: Electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply	Voltage: 24 V (20.4 ... 28.8 V)
	+	Electronics power supply	
	M	Electronics ground	Max. current via jumper in connector: 20 A (15 A according to UL/CSA)
	M	Electronics ground	
Type: Screw terminal 2 (Page 384)			

The maximum cable length that can be connected is 30 m.

Note

The two "+" and "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

9.1.2.3 Meaning of the LEDs

Table 9- 4 Meaning of the LEDs on the Sensor Module Cabinet-Mounted SMC10

LED	Color	Status	Description, cause	Remedy
RDY READY	-	Off	The electronics power supply is missing or outside the permissible tolerance range.	-
	Green	Continuous light	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	-
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	-

LED	Color	Status	Description, cause	Remedy
	Red	Continuous light	This component has at least one fault. Note: The LED is activated irrespective of whether the corresponding messages have been reconfigured.	Remove and acknowledge the fault.
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON.
	Green/orange or Red/orange	Flashing light 2 Hz	Component recognition via LED is activated (p0144=1). Note: Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0144 to "1").	–

9.1.2.4 Dimension drawing

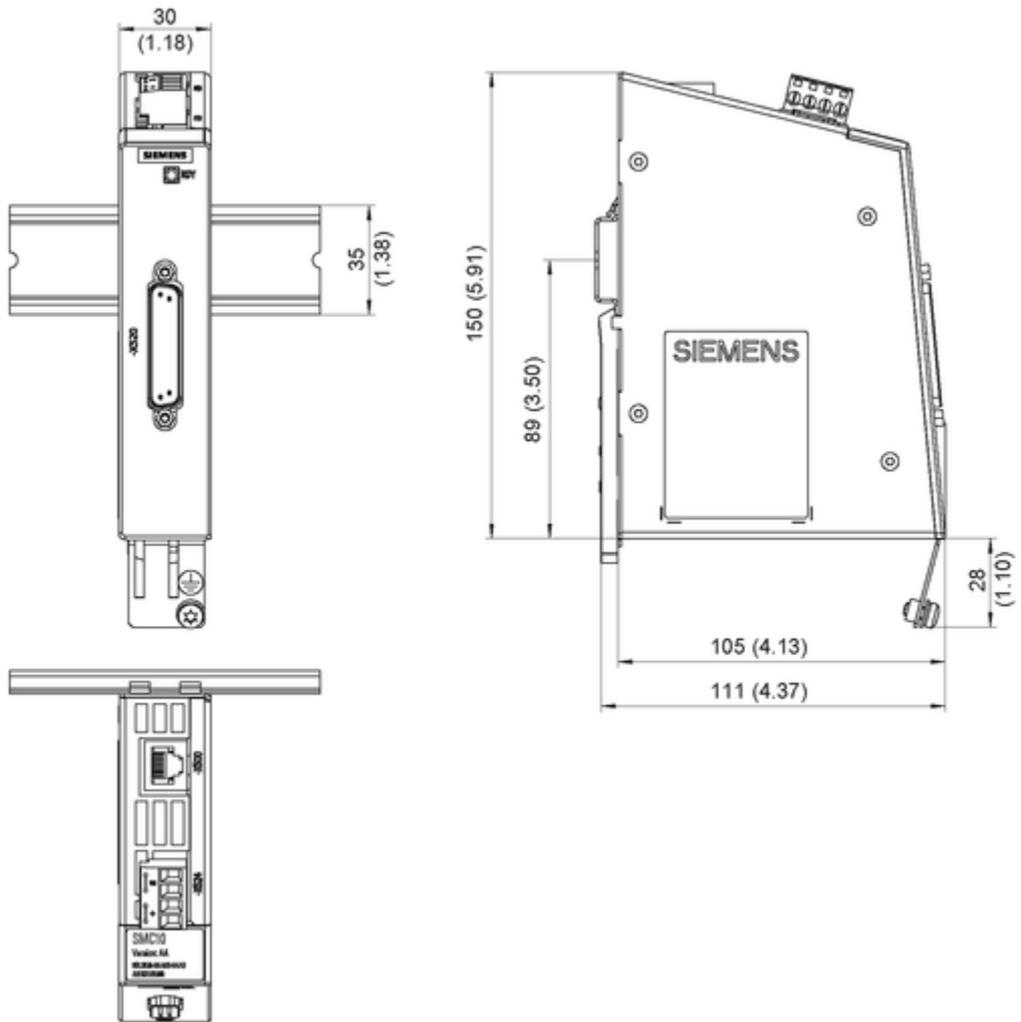


Figure 9-2 Dimension drawing of the Sensor Module Cabinet SMC10, all dimensions in mm and (inches)

9.1.2.5 Mounting

Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the components along the mounting rail to either the left or right up to their final position.

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.

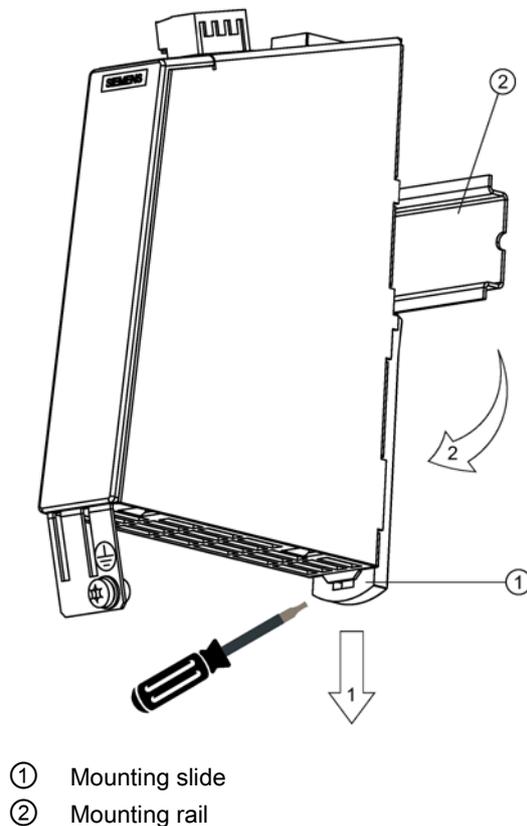


Figure 9-3 Removing from a DIN mounting rail

9.1.2.6 Technical specifications

Table 9- 5 Technical specifications

6SL3055-0AA00-5AA.	Unit	Value
Electronics power supply		
Voltage	V _{DC}	24 (20.4 ... 28.8)
Current (without encoder system)	A _{DC}	≤0.2
Power loss	W	≤4
Max. cable length	m	30
Specification		
Transformation ratio of the resolver (\ddot{u})		0.5
Excitation voltage on the SMC10 when $\ddot{u}=0.5$	V _{rms}	4.1
Amplitude monitoring threshold (secondary tracks) of the SMC10	V _{rms}	1
Excitation voltage (cannot be parameterized)	V _{rms}	4.1
Excitation frequency (synchronized to the current controller clock cycle)	kHz	5 to 16
Protective conductor/ground connection	At the housing with M4 screw	
Max. encoder cable length	m	130
Ventilation clearances, above/below	mm	50
Weight	kg	0.41

Table 9- 6 Max. frequency that can be evaluated (speed)

Resolver		Max. speed resolver / motor		
Number of poles	Number of pole pairs	8 kHz / 125 μs	4 kHz / 250 μs	2 kHz / 500 μs
2-pole	1	120000 rpm	60000 rpm	30000 rpm
4-pole	2	60000 rpm	30000 rpm	15000 rpm
6-pole	3	40000 rpm	20000 rpm	10000 rpm
8-pole	4	30000 rpm	15000 rpm	7500 rpm

The ratio between the ohmic resistance R and the inductance L (the primary winding of the resolver) determines whether the resolver can be evaluated with the SMC10. See the following diagram:

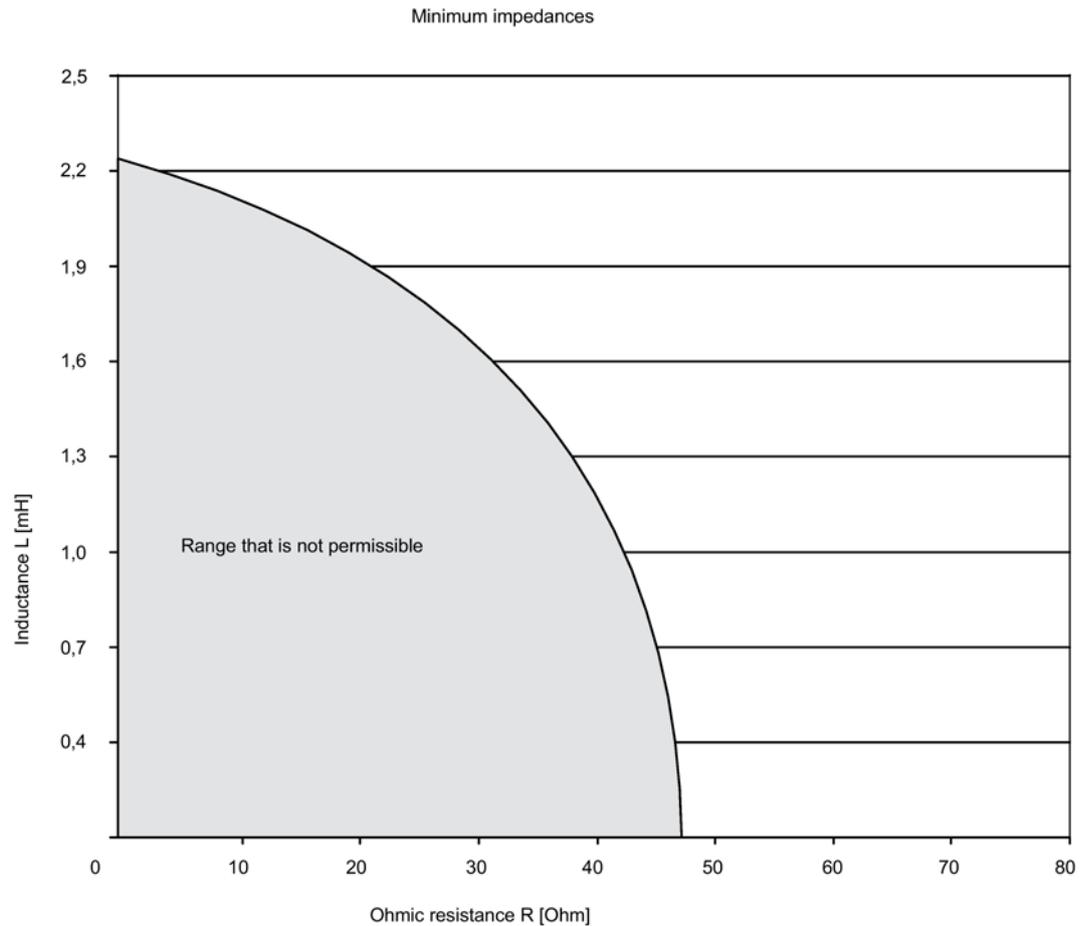


Figure 9-4 Rotor impedances that can be connected with excitation frequency $f = 5000$ Hz

To check as shown in the figure above, the impedances Z_{rs} or Z_{ro} (impedance between R1 and R2 with short-circuited or open outputs) from the encoder manufacturer's data sheet must be used.

9.1.3 Sensor Module Cabinet-Mounted SMC20

9.1.3.1 Description

The Sensor Module Cabinet-Mounted SMC20 is an expansion module for snapping on to a standard mounting rail acc. to EN 60715. It evaluates encoder signals and transmits the speed, actual position, rotor position and, if applicable, the motor temperature and reference point via DRIVE-CLiQ to the Control Unit.

Following encoder systems can be connected:

- Incremental encoder SIN/COS (1 Vpp) with and without reference signal
- Absolute encoder EnDat 2.1 (with SIN/COS incremental signals 1 Vpp)
- Absolute encoder EnDat 2.2 with order designation EnDat01 or EnDat02

9.1 Sensor Modules

- Absolute encoder SSI (with 5 V supply)
- Absolute encoder SSI (with 5 V supply) with SIN/COS incremental signals 1 Vpp

9.1.3.2 Interface description

Overview

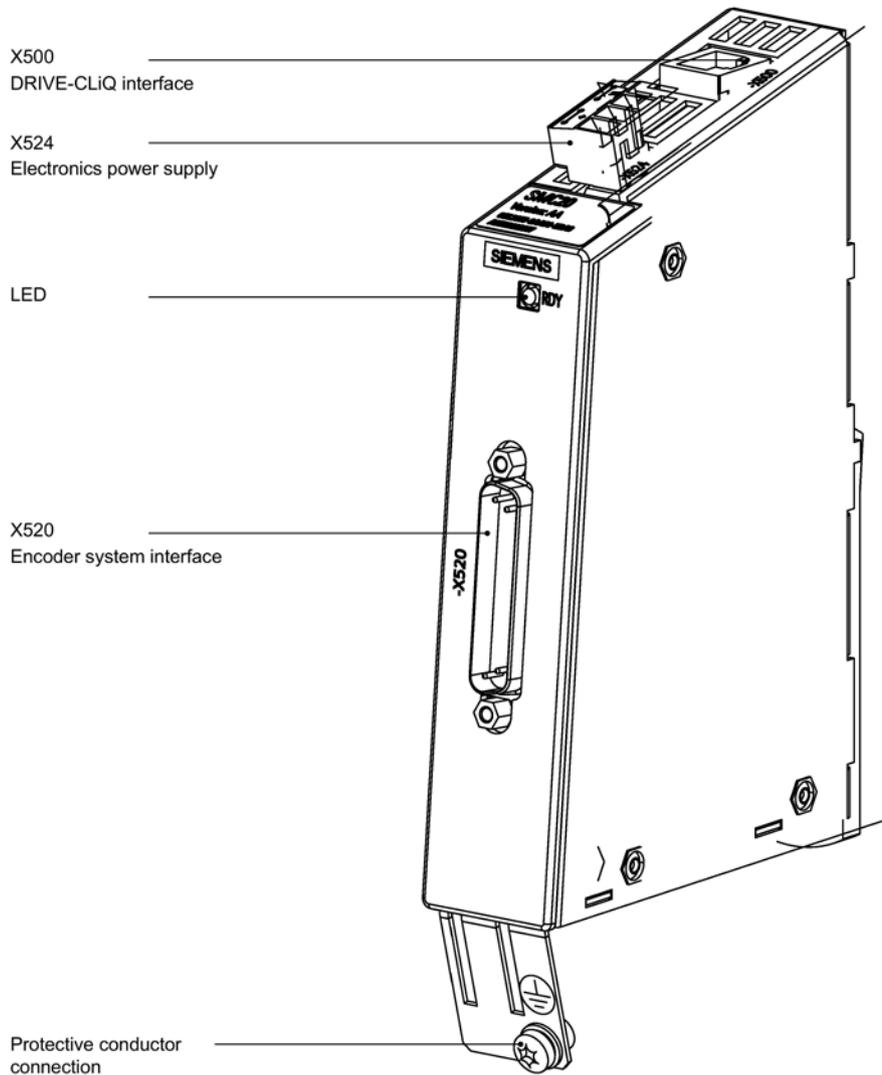
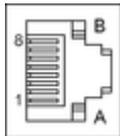


Figure 9-5 Interface description of the SMC20

X500 DRIVE-CLiQ interface

Table 9- 7 X500: DRIVE-CLiQ interface

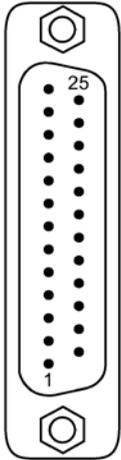
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	Reserved, do not use	-
	B	M (0 V)	Electronics ground
	Connector type	DRIVE-CLiQ socket	

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

Blanking covers (50 x) Article No.: 6SL3066-4CA00-0AA0

X520 encoder system interface

Table 9- 8 X520: Encoder system interface



Pin	Signal name	Technical data
1	P encoder	Encoder power supply
2	M encoder	Ground, encoder power supply
3	A	Incremental signal A
4	A*	Inverse incremental signal A
5	Ground	Ground (for internal shield)
6	B	Incremental signal B
7	B*	Inverse incremental signal B
8	Ground	Ground (for internal shield)
9	Reserved, do not use	-
10	Clock	Clock, EnDat interface, SSI clock
11	Reserved, do not use	-
12	Clock*	Inverted clock, EnDat interface, inverted SSI clock
13	+Temp ¹⁾	KTY84-130 / Pt1000 / PTC temperature sensors
14	P sense	Sense input encoder power supply
15	Data	Data, EnDat interface, SSI data
16	M sense	Ground sense input encoder power supply
17	R	Reference signal R
18	R*	Inverse reference signal R
19	C	Absolute track signal C
20	C*	Inverse absolute track signal C
21	D	Absolute track signal D
22	D*	Inverse absolute track signal D
23	Data*	Inverse data, EnDat interface, Inverse SSI data
24	Ground	Ground (for internal shield)
25	-Temp ¹⁾	KTY84-130 / Pt1000 / PTC temperature sensors
Connector type:	25-pin SUB D connector	
Measuring current via temperature sensor connection: 2 mA		

1) Accuracy of the temperature measurement:
 - KTY: ±7 °C (including evaluation)
 - Pt1000: ±5 °C (Pt1000 tolerance class B according to EN 60751 including evaluation)
 - PTC: ±5 °C (including evaluation)

NOTICE
Damage to motor due to incorrectly connected KTY temperature sensor
If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.
<ul style="list-style-type: none"> • Connect a KTY temperature sensor with the correct polarity.

Information for assigning parameters to the KTY temperature sensor can be found in the SINAMICS S120 Function Manual "Drive Functions" in the Chapter "Monitoring and protection functions/thermal motor protection".



! WARNING
Electric shock in the event of voltage flashovers at the temperature sensor
Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.
<ul style="list-style-type: none"> • Use temperature sensors that comply with the specifications relating to protective separation. • If safe electrical separation cannot be guaranteed (e.g. for linear motors or third-party motors), use a SME120 or SME125 Sensor Module External or the TM120 Terminal Module.

X524 electronics power supply

Table 9- 9 X524 electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply	Voltage: 24 V (20.4 ... 28.8 V)
	+	Electronics power supply	
	GND	Electronics ground	Maximum current via jumper in connector: 20 A (15 A according to UL/CSA)
	GND	Electronics ground	
Type: Screw-type terminal 2 (Page 384) Max. cross-section that can be connected: 2.5 mm ² (AWG 14)			

The maximum cable length that can be connected is 30 m.

Note

The two "+" and/or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

9.1.3.3 Meaning of the LEDs

Table 9- 10 Meaning of the LEDs on the Sensor Module Cabinet-Mounted SMC20

LED	Color	Status	Description, cause	Remedy
RDY READY	-	Off	The electronics power supply is missing or outside the permissible tolerance range.	-
	Green	Continuous light	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	-
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	-
	Red	Continuous light	This component has at least one fault. Note: The LED is activated irrespective of whether the corresponding messages have been reconfigured.	Remove and acknowledge the fault.
	Green / Red	Flashing light 0.5 Hz	Firmware is being downloaded.	-
		Flashing light 2 Hz	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON.
	Green / Orange or Red / Orange	Flashing light 2 Hz	Component recognition via LED is activated (p0144=1). Note: Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0144 to "1").	-

9.1.3.4 Dimension drawing

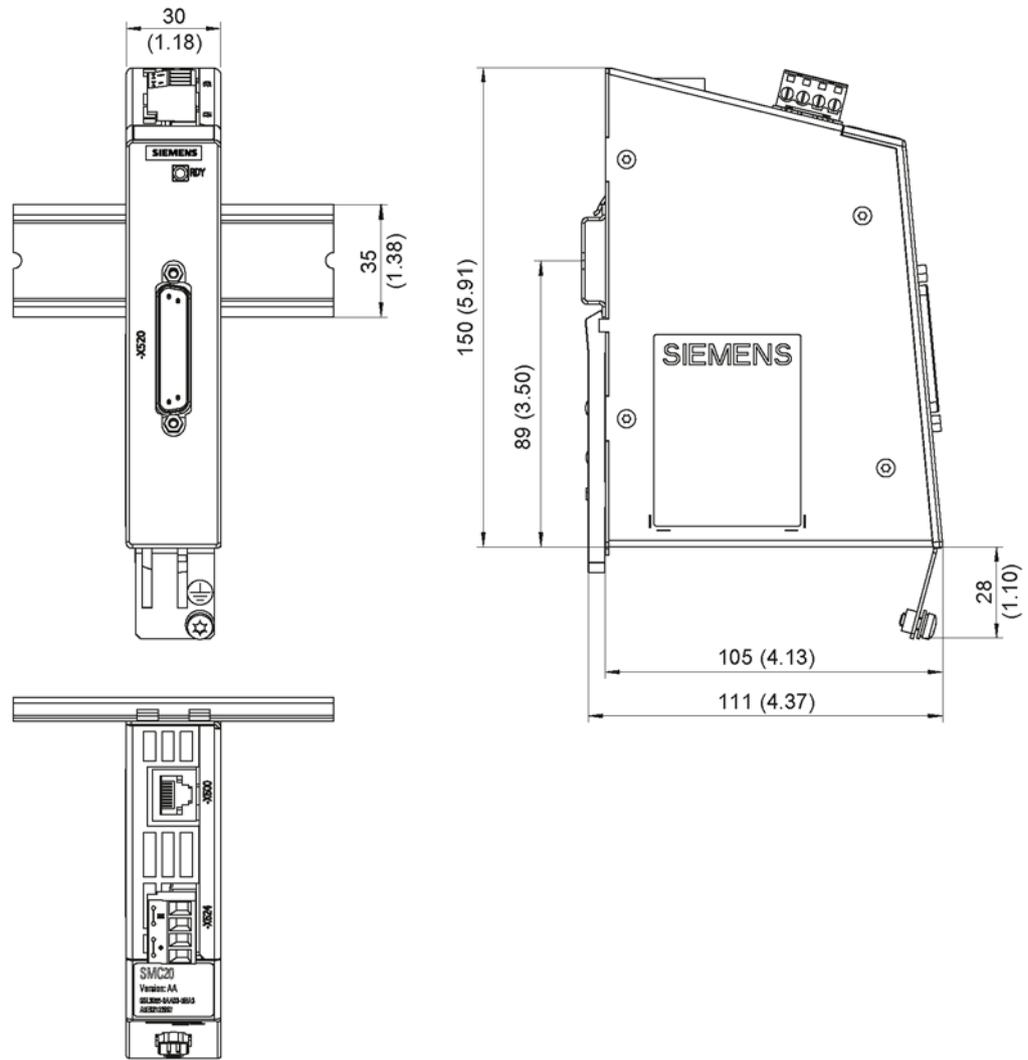


Figure 9-6 Dimension drawing of the Sensor Module Cabinet SMC20, all data in mm and (inches)

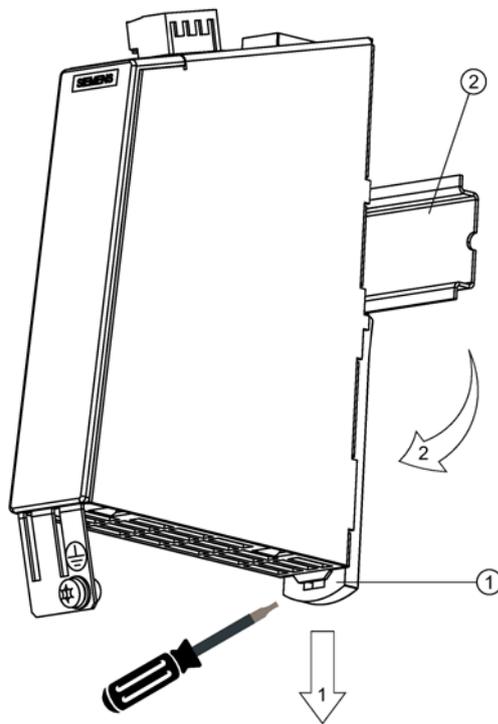
9.1.3.5 Mounting

Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the components along the mounting rail to either the left or right up to their final position.

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.



- ① Mounting slide
- ② Mounting rail

Figure 9-7 Removing from a DIN mounting rail

9.1.3.6 Technical data

Table 9- 11 Technical data

6SL3055-0AA00-5BA.	Unit	Value
Electronics power supply		
Voltage	V _{DC}	24 (20.4 ... 28.8)
Current (without encoder system)	A _{DC}	≤0.2
Power loss	W	≤4
Max. Cable length	m	30
Encoder system power supply		
Voltage	V _{DC}	5 V DC (with remote sense) ¹⁾
Current	A _{DC}	0.35
Encoder frequency that can be evaluated (f _{encoder})	kHz	≤ 500
SSI baud rate ²⁾	kBd	100 - 1000 ³⁾
Max. encoder cable length	m	100
Protective conductor/ground connection		At the housing with M4 screw
Ventilation clearances, above/below	mm	50
Weight	kg	0.41

- 1) A controller compares the encoder system supply voltage - sensed via the Remote Sense cables - with the reference supply voltage of the encoder system, and adjusts the supply voltage for the encoder system at the output of the sensor module until the required supply voltage is obtained directly at the encoder system (only for 5 V encoder system power supply).
- 2) Only possible for SSI encoders with 5 V supply.
- 3) See the diagram "Maximum cable length depending on the SSI baud rate for SSI encoders"

Note

Current controller clock cycle

For a current controller cycle clock of 31.25 μs, use an SMC20 with Article No. 6SL3055-0AA00-5BA3.

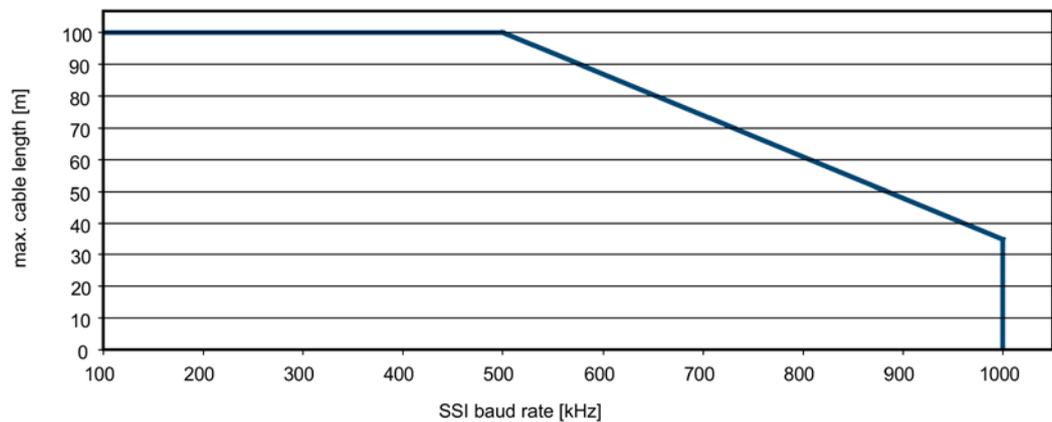


Figure 9-8 Maximum cable lengths depending on the SSI baud rate for SSI encoders

9.1.4 Sensor Module Cabinet-Mounted SMC30

9.1.4.1 Description

The Sensor Module Cabinet-Mounted SMC30 is an expansion module for snapping on to a standard mounting rail acc. to EN 60715. It evaluates encoder signals and transmits the speed, actual position, and, if applicable, the motor temperature and reference point via DRIVE-CLiQ to the Control Unit.

The SMC30 is used to evaluate encoder signals from encoders with TTL, HTL, or SSI interfaces.

A combination of TTL/HTL signal and SSI absolute signal is possible at terminals X521/X531, if both signals are derived from the same measured variable.

9.1.4.2 Interface description

Overview

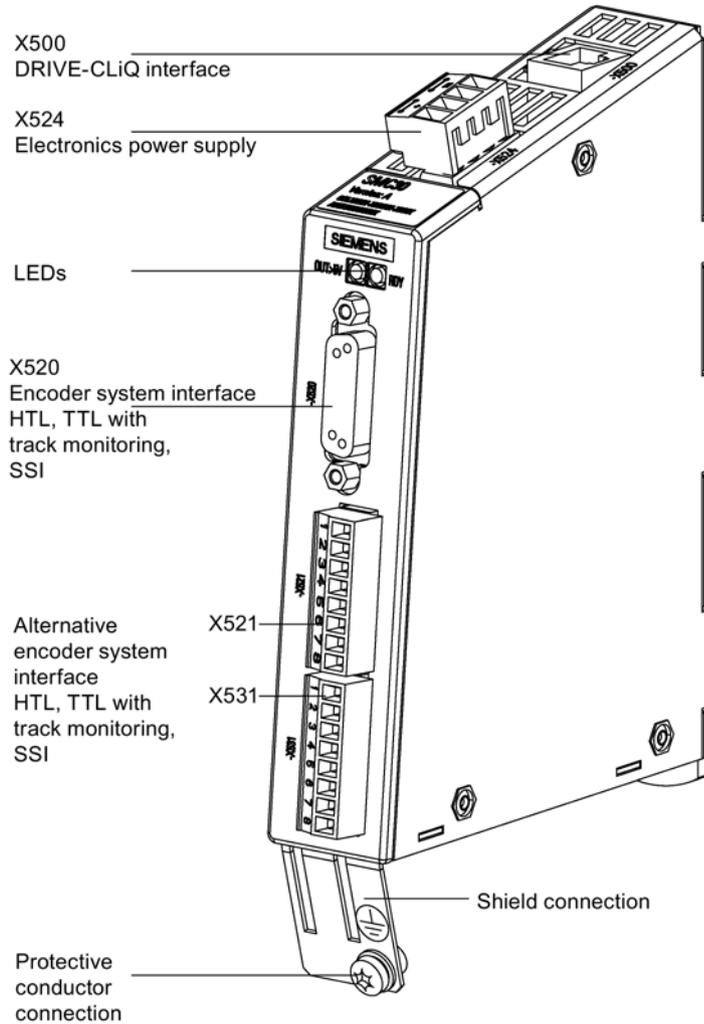
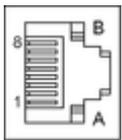


Figure 9-9 Interface description of the SMC30

X500 DRIVE-CLiQ interface

Table 9- 12 X500: DRIVE-CLiQ interface

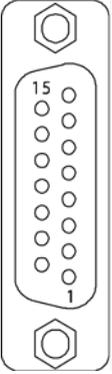
	Pin	Signal name	Technical data
	1	TXP	Transmit data +
	2	TXN	Transmit data -
	3	RXP	Receive data +
	4	Reserved, do not use	-
	5	Reserved, do not use	-
	6	RXN	Receive data -
	7	Reserved, do not use	-
	8	Reserved, do not use	-
	A	Reserved, do not use	-
	B	M (0 V)	Electronics ground
Connector type	DRIVE-CLiQ socket		

The blanking cover for the DRIVE-CLiQ port is included in the scope of delivery.

Blanking covers (50 x) Article No.: 6SL3066-4CA00-0AA0

X520 encoder system interface

Table 9- 13 X520: Encoder system interface

	Pin	Signal name	Technical data
	1	+Temp ¹⁾	KTY84-130 / Pt1000 / PTC temperature sensors
	2	Clock	SSI clock
	3	Clock*	Inverse SSI clock
	4	P encoder 5 V / 24 V	Encoder power supply
	5	P encoder 5 V / 24 V	
	6	P sense	Sense input encoder power supply
	7	M encoder (M)	Ground, encoder power supply
	8	- Temp ¹⁾	KTY84-130 / Pt1000 / PTC temperature sensors
	9	M sense	Ground sense input
	10	R	Reference signal R
	11	R*	Inverse reference signal R
	12	B*	Inverse incremental signal B
	13	B	Incremental signal B
	14	A* / data*	Inverted incremental signal A/inverted SSI data
	15	A / data	Incremental signal A/SSI data
Connector type:	15-pin Sub-D socket		
Measuring current via temperature sensor connection: 2 mA			

1) Accuracy of the temperature measurement:

- KTY: ±7 °C (including evaluation)
- Pt1000: ±5 °C (Pt1000 tolerance class B according to EN 60751 including evaluation)
- PTC: ±5 °C (including evaluation)

NOTICE**Damage to the encoder due to incorrect supply voltage**

The encoder supply can be parameterized to 5 V or 24 V. Incorrect parameter assignment can cause damage to the encoder.

- Select the appropriate supply voltage.

NOTICE**Damage to motor due to incorrectly connected KTY temperature sensor**

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

- Connect a KTY temperature sensor with the correct polarity.

Information for assigning parameters to the KTY temperature sensor can be found in the SINAMICS S120 Function Manual "Drive Functions" in the Chapter "Monitoring and protection functions/thermal motor protection".

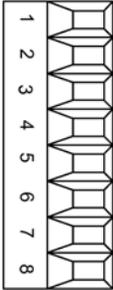
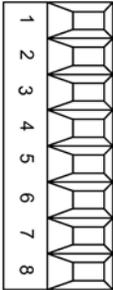
**! WARNING****Electric shock in the event of voltage flashovers at the temperature sensor**

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that comply with the specifications relating to protective separation.
- If safe electrical separation cannot be guaranteed (e.g. for linear motors or third-party motors), use a SME120 or SME125 Sensor Module External or the TM120 Terminal Module.

X521 / X531 alternative encoder system interface

Table 9- 14 X521/X531: Alternative encoder system interface

	Pin	Designation	Technical data
<p>X521</p> 	1	A	Incremental signal A
	2	A*	Inverse incremental signal A
	3	B	Incremental signal B
	4	B*	Inverse incremental signal B
	5	R	Reference signal R
	6	R*	Inverse reference signal R
	7	CTRL	Control signal
	8	M	Ground
<p>X531</p> 	1	P_Encoder 5 V / 24 V	Encoder power supply
	2	M_Encoder	Ground, encoder power supply
	3	-Temp ¹⁾	KTY84-130 / Pt1000 / PTC temperature sensors
	4	+Temp ¹⁾	KTY84-130 / Pt1000 / PTC temperature sensors
	5	Clock	SSI clock
	6	Clock*	Inverse SSI clock
	7	Data	SSI data
	8	Data*	Inverse SSI data
<p>Max. connectable cross-section: 1.5 mm² (AWG 16) Measuring current via temperature sensor connection 2 mA When unipolar HTL encoders are used, A*, B*, and R* on the terminal block must be jumpered with M_Encoder (X531)²⁾.</p>			

- 1) Accuracy of the temperature measurement:
 - KTY: ±7 °C (including evaluation)
 - Pt1000: ±5 °C (Pt1000 tolerance class B according to EN 60751 including evaluation)
 - PTC: ±5 °C (including evaluation)
- 2) Because the physical transmission media is more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.



 WARNING
<p>Electric shock due to unconnected cable shields</p> <p>Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.</p> <ul style="list-style-type: none"> • Attach the cable shield to the component for the encoder system connection at the terminals.

Temperature sensor connection**NOTICE****Damage to motor due to incorrectly connected KTY temperature sensor**

If a KTY temperature sensor is connected with incorrect polarity, it is not possible to detect when the motor overheats. Overheating can cause damage to the motor.

- Connect a KTY temperature sensor with the correct polarity.

Information for assigning parameters to the KTY temperature sensor can be found in the SINAMICS S120 Function Manual "Drive Functions" in the Chapter "Monitoring and protection functions/thermal motor protection".

Note

The maximum length of the temperature sensor cable is 100 m. The cables must be shielded.

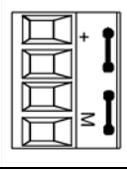
**! WARNING****Electric shock in the event of voltage flashovers at the temperature sensor**

Voltage flashovers in the signal electronics can occur in motors without safe electrical separation of the temperature sensors.

- Use temperature sensors that comply with the specifications relating to protective separation.
- If safe electrical separation cannot be guaranteed (for linear motors or third-party motors, for example), use a Sensor Module External (SME120 or SME125) or Terminal Module TM120.

X524 Electronics power supply

Table 9- 15 X524: Electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply	Voltage: 24 V (20.4 ... 28.8 V)
	+	Electronics power supply	
	M	Electronics ground	Max. current via jumper in connector: 20 A (15 A according to UL/CSA)
	M	Electronics ground	
Type: Screw terminal 2 (Page 384)			

The maximum cable length that can be connected is 30 m.

Note

The two "+" and/or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

9.1.4.3 Connection examples

Connection example 1: HTL encoder, bipolar, with reference signal

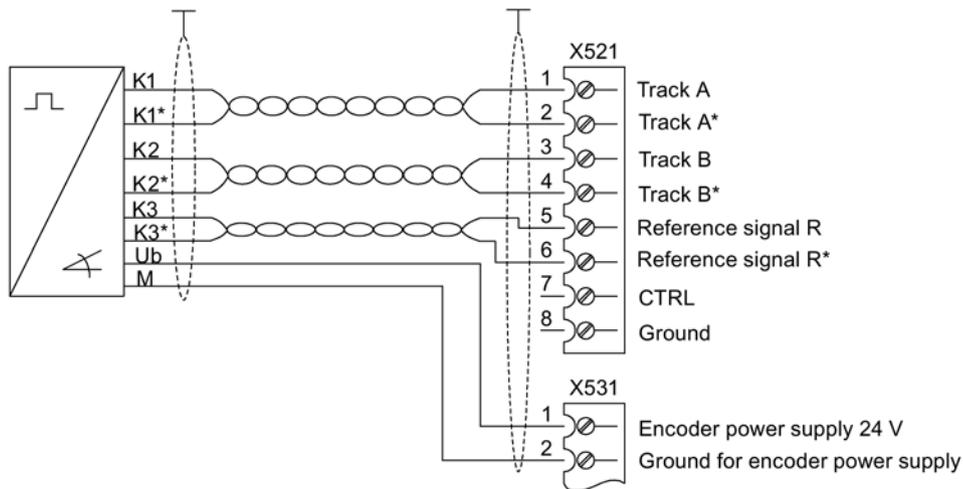


Figure 9-10 Connection example 1: HTL encoder, bipolar, with reference signal

Signal cables must be twisted in pairs to improve immunity to induced noise.

Connection example 2: HTL encoder, unipolar, with reference signal

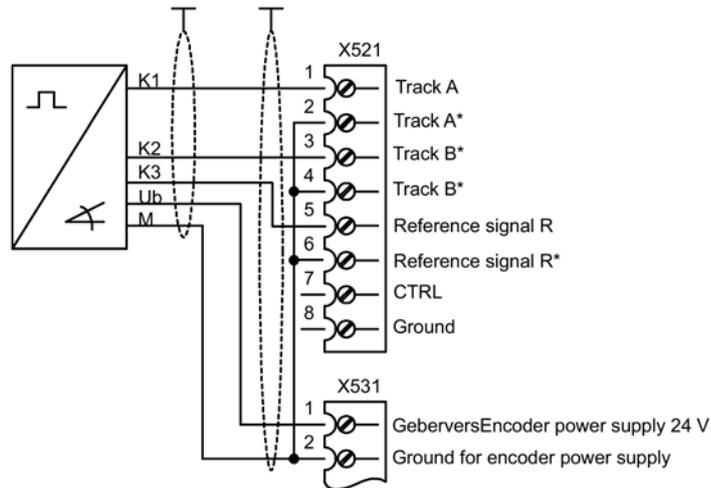


Figure 9-11 Connection example 2: HTL encoder, unipolar, with reference signal¹⁾

¹⁾ Because the physical transmission media is more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.



Figure 9-12 Photo of connection example 2: SMC30, 30 mm wide

The photo above shows the wire jumpers for connecting unipolar HTL encoders with a reference signal.

9.1.4.4 Meaning of the LEDs

Meaning of LEDs on the Sensor Module Cabinet-Mounted SMC30

Table 9- 16 Meaning of LEDs on the Sensor Module Cabinet SMC30

LED	Color	Status	Description, cause	Remedy
RDY READY	–	Off	The electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation. Cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Note: LED is controlled irrespective of the corresponding messages being reconfigured.	Correct fault and acknowledge
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
	Green/red	Flashing light 2 Hz	Firmware download is complete. The system waits for POWER ON.	Carry out a POWER ON
	Green/orange or Red/orange	Flashing light 2 Hz	Component recognition via LED is activated (p0144=1). Note: Whether the LED flashes green/orange or red/orange depends on the status the LED had during activation (setting of parameter p0144 to "1").	–
OUT > 5 V	–	Off	The electronics power supply is missing or outside permissible tolerance range. Power supply ≤ 5 V.	–
	Orange	Continuous light	The electronics power supply for the encoder system is available. Power supply > 5 V	–

9.1.4.5 Dimension drawing

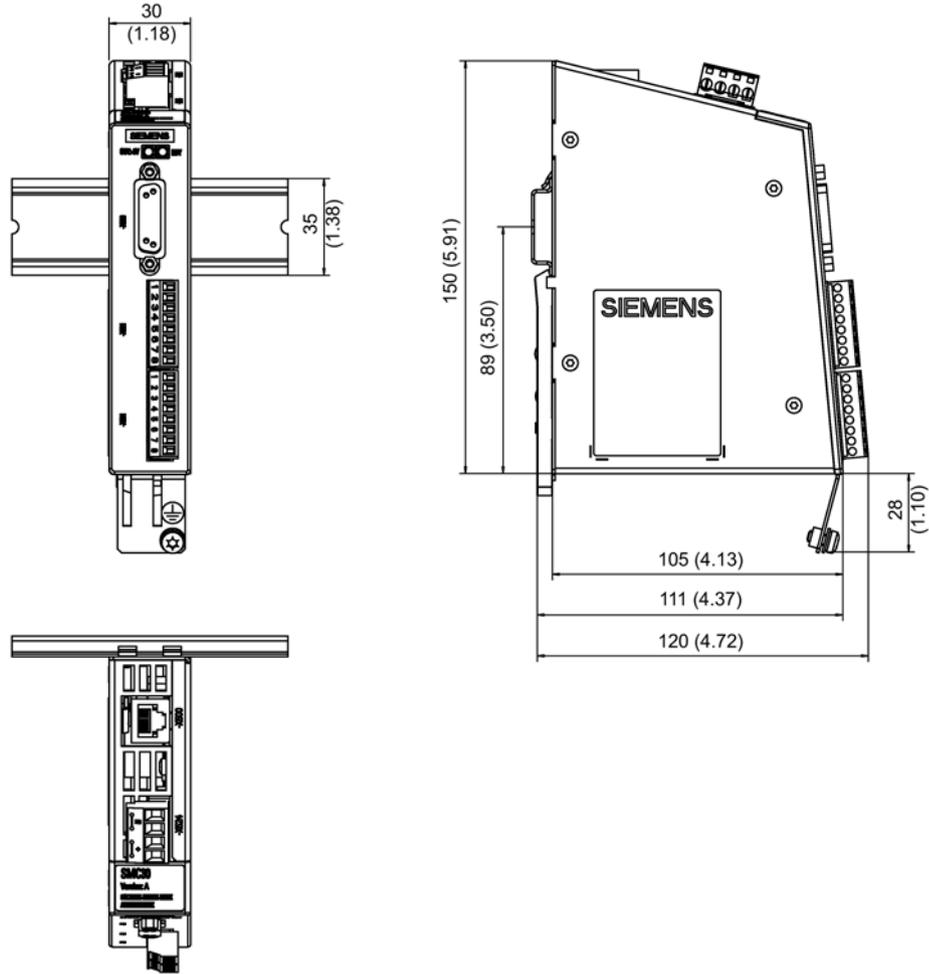


Figure 9-13 Dimension drawing of the Sensor Module Cabinet SMC30, all data in mm and (inches)

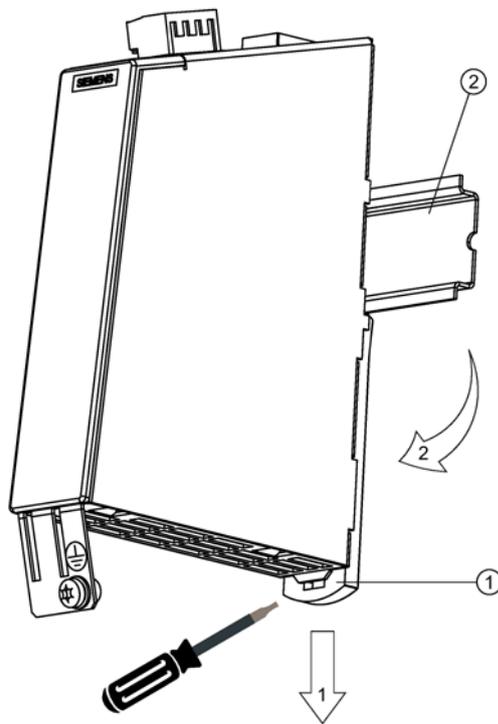
9.1.4.6 Mounting

Installation

1. Tilt the component backwards slightly and attach it to the DIN rail using the hooks.
2. Swivel the component onto the DIN rail until you hear the mounting slide at the rear latch into position.
3. Slide the components along the mounting rail to either the left or right up to their final position.

Removal

1. First shift the mounting slide downwards at the lug to release the interlocking with the mounting rail.
2. Swivel the component to the front and withdraw it upwards from the DIN rail.

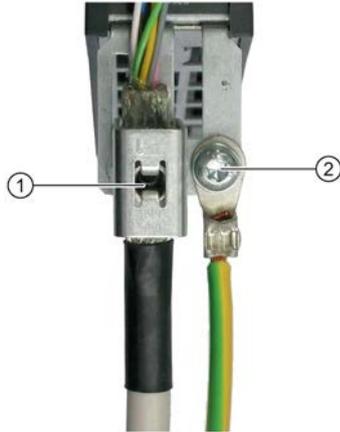


- ① Mounting slide
- ② Mounting rail

Figure 9-14 Removing from a DIN mounting rail

9.1.4.7 Protective conductor connection and shield support

Shield contacts are only required if the system is connected to X521/X531.



- ① Shield connection terminal, Weidmüller company, type: KLBUE CO1, Article number: 1753311001
- ② Protective conductor connection M4 / 1.8 Nm (15.9 lbf in)

Figure 9-15 Protective conductor connection and shield support

The bending radii of the cables must be observed (see MOTION-CONNECT description).

NOTICE

Damage or faulty operation due to incorrect shielding or inadmissible cable lengths

If the correct shielding procedures or the permissible cable lengths are not observed, it can cause damage or the machine may malfunction.

- Only use shielded cables.
- Do not exceed the cable lengths stated in the technical data.

9.1.4.8 Technical specifications

Table 9- 17 Technical specifications

6SL3055-0AA00-5CA2	Unit	Value
Electronics power supply		
Voltage	V _{DC}	24 (20.4 ... 28.8)
Current (without encoder system)	A _{DC}	≤0.2
Power loss	W	≤4
Max. cable length	m	30
Encoder system power supply		
Voltage	V _{DC}	5 (with or without remote sense) ¹⁾ or V _{DC} - 1 V
Current	A _{DC}	0.35
Encoder frequency that can be evaluated (f _{encoder})	kHz	≤ 300
SSI baud rate	kBd	100 - 1000 ²⁾
Protective conductor/ground connection		At the housing with M4 screw
Ventilation clearances, above/below	mm	50
Weight	kg	0.41

- 1) A controller compares the encoder system supply voltage - sensed via the Remote Sense cables - with the reference supply voltage of the encoder system, and adjusts the supply voltage for the encoder system at the output of the sensor module until the required supply voltage is obtained directly at the encoder system (only for 5 V encoder system power supply). Remote Sense only to X520.
- 2) See the diagram "Maximum cable length depending on the SSI baud rate for SSI encoders"

Connectable encoder systems

Table 9- 18 Specification of encoder systems that can be connected

Parameter	Designation	Threshold	Min.	Max.	Unit
High signal level (TTL bipolar at X520 or X521/X531) ¹⁾	U _{Hdiff}	-	2	5	V
Low signal level (TTL bipolar at X520 or X521/X531) ¹⁾	U _{Ldiff}	-	-5	-2	V
High signal level (HTL unipolar)	U _H ³⁾	High	17	V _{CC}	V
		Low	10	V _{CC}	V
Low signal level (HTL unipolar)	U _L ³⁾	High	0	7	V
		Low	0	2	V
High signal level (HTL bipolar) ²⁾	U _{Hdiff}	-	3	V _{CC}	V
Low signal level (HTL bipolar) ²⁾	U _{Ldiff}	-	-V _{CC}	-3	V
High signal level (SSI bipolar at X520 or X521/X531) ¹⁾	U _{Hdiff}	-	2	5	V
Low signal level (SSI bipolar at X520 or X521/X531) ¹⁾	U _{Ldiff}	-	-5	-2	V
Signal frequency	f _s	-	-	300	kHz

Parameter	Designation	Threshold	Min.	Max.	Unit
Edge clearance	t_{\min}	-	100	-	ns
"Zero pulse inactive time" (before and after A=B=high)	t_{Lo}	-	640	$(t_{ALo-BHi} - t_{Hi})/2^4$	ns
"Zero pulse active time" (while A=B=high and beyond) ⁵⁾	t_{Hi}	-	640	$t_{ALo-BHi} - 2 t_{Lo}^4$	ns

- 1) Other signal levels according to the RS 422 standard.
- 2) The absolute level of the individual signals varies between 0 V and V_{CC} of the encoder system.
- 3) Only with Article No. 6SL3055-0AA00-5CA2 and firmware version 2.5 SP1 or higher can this value be configured using software. For older firmware releases and Article Nos. less than 6SL3055-0AA00-5CA2, the "low" threshold applies.
- 4) $t_{ALo-BHi}$ is not a specified value, but is the time between the falling edge of track A and the next but one rising edge of track B.
- 5) Additional information on setting the "Zero pulse active time" can be found in the manual: SINAMICS S120, Function Manual, "Tolerant encoder monitoring for SMC30".

Table 9- 19 Encoders that can be connected

	X520 (SUB-D)	X521 (terminal)	X531 (terminal)	Track monitoring	Remote Sense ²⁾
HTL bipolar 24 V	Yes	Yes		Yes	No
HTL unipolar 24 V ¹⁾	Yes	Yes (however, a bipolar connection is recommended) ¹⁾		No	No
TTL bipolar 24 V	Yes	Yes		Yes	No
TTL bipolar 5 V	Yes	Yes		Yes	At X520
SSI 24 V/5 V	Yes	Yes		No	No
TTL unipolar	No				

- 1) Because the physical transmission media is more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.
- 2) A controller compares the encoder system supply voltage - sensed via the Remote Sense cables - with the reference supply voltage of the encoder system, and adjusts the supply voltage for the encoder system at the output of the sensor module until the required supply voltage is obtained directly at the encoder system (only for 5 V encoder system power supply).

Maximum encoder cable lengths

Note

The maximum cable lengths according to the following table must not be exceeded even when longer cable lengths can be calculated.

Table 9- 20 Maximum encoder cable length

Encoder type	Maximum encoder cable length in m
TTL ¹⁾	100
HTL unipolar ²⁾	100
HTL bipolar	300
SSI	100 ³⁾

- 1) For TTL encoders at X520 → Remote Sense → 100 m
- 2) Because the physical transmission media is more robust, the bipolar connection should always be used. The unipolar connection should only be used if the encoder type does not output push-pull signals.
- 3) See the diagram "Maximum cable length depending on the SSI baud rate for SSI encoders"

SSI encoder

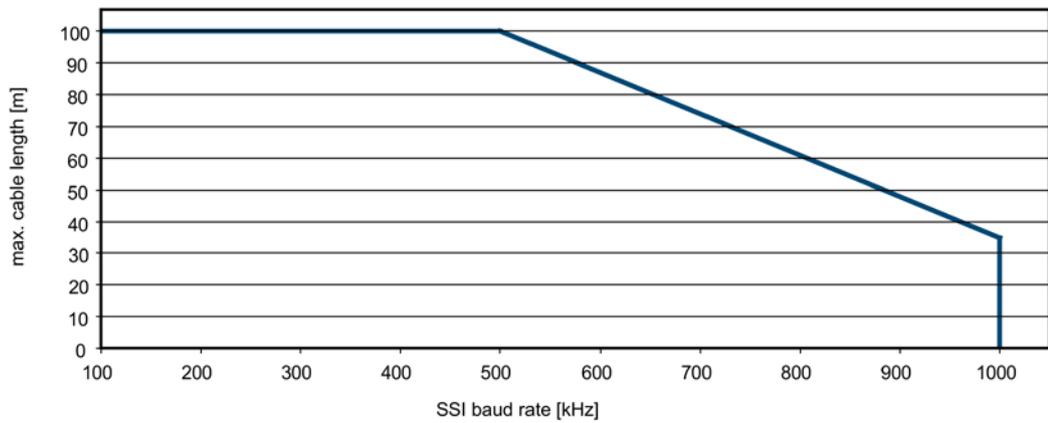


Figure 9-16 Maximum cable lengths depending on the SSI baud rate for SSI encoders

Encoders with 5 V supply connected to X521/X531

For encoders with 5 V supply at X521/X531 (no Remote Sense available), the maximum cable length¹⁾ depends on the encoder current. The following diagram shows an example of a 0.5 mm² conductor cross section.

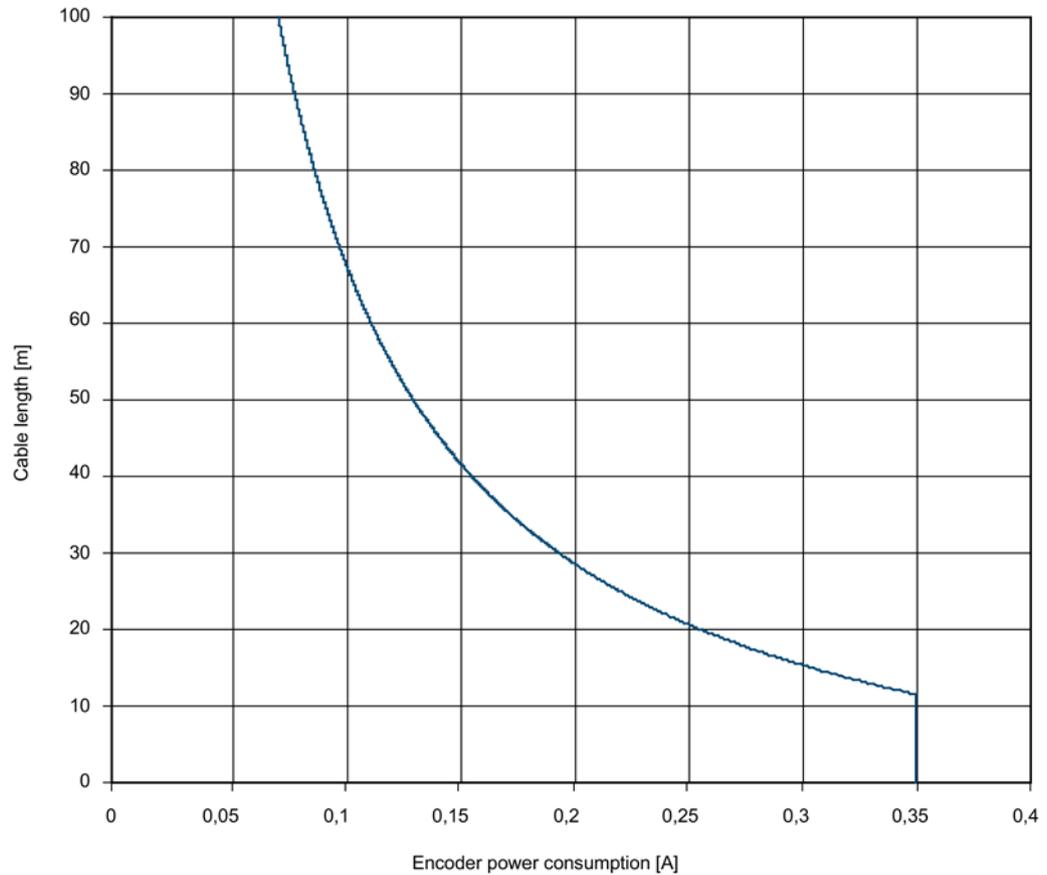


Figure 9-17 Max. cable length as a function of the encoder current drawn

¹⁾ When encoders without Remote Sense are used, the permissible cable length is limited to 100 m because the voltage drop depends on the cable length and the encoder current.

9.1 Sensor Modules

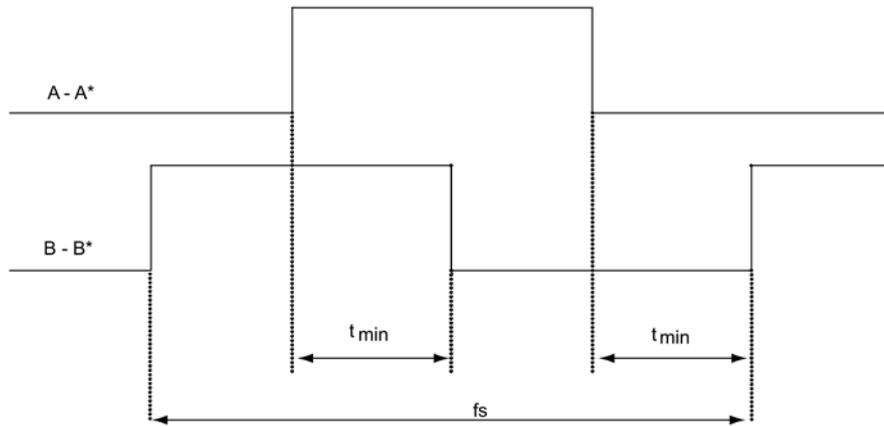


Figure 9-18 Signal characteristic of track A and track B between two edges: Time between two edges with pulse encoders

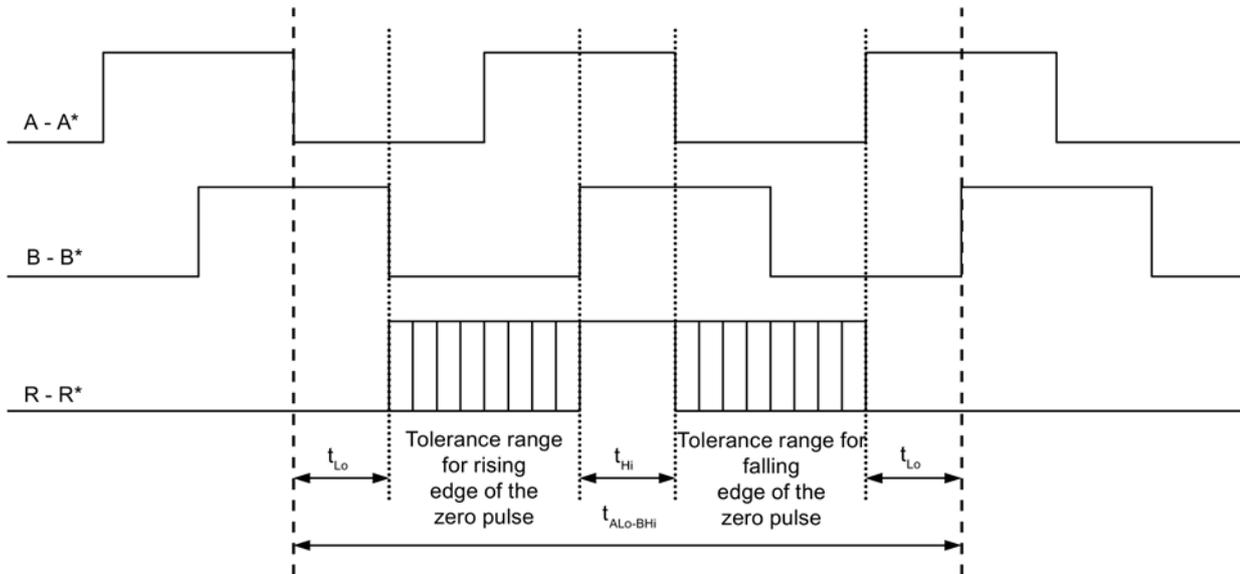


Figure 9-19 Position of the zero pulse to the track signals

9.2 DRIVE-CLiQ encoder

9.2.1 Description

The DRIVE-CLiQ encoder is available as an absolute encoder with integrated DRIVE-CLiQ interface. The multiturn design of the encoder senses absolute position values extending over 4096 revolutions. The single-turn design senses the absolute position within a revolution.

The most important advantages are:

- Automatic commissioning via DRIVE-CLiQ
- High operating temperatures of 100 °C are possible
- Integrated diagnostics concept
- Safety-related applications possible with Safety Integrated

Table 9- 21 Encoder for mounting with DRIVE-CLiQ

Article No.	Description
6FX2001-5FD13-1AA0	Absolute encoder with DRIVE-CLiQ, single-turn, synchro flange VW 6 mm
6FX2001-5QD13-1AA0	Absolute encoder with DRIVE-CLiQ, single-turn, clamping flange VW 10 mm
6FX2001-5VD13-1AA0	Absolute encoder with DRIVE-CLiQ, single-turn, hollow shaft 10 mm
6FX2001-5WD13-1AA0	Absolute encoder with DRIVE-CLiQ, Single-turn, hollow shaft 12 mm
6FX2001-5FD25-1AA0	Absolute encoder with DRIVE-CLiQ, Multiturn, synchro flange VW 6 mm
6FX2001-5QD25-1AA0	Absolute encoder with DRIVE-CLiQ, Multiturn, clamping flange VW 10 mm
6FX2001-5VD25-1AA0	Absolute encoder with DRIVE-CLiQ, Multiturn, hollow shaft 10 mm
6FX2001-5WD25-1AA0	Absolute encoder with DRIVE-CLiQ, Multiturn, hollow shaft 12 mm

The rotary encoders for absolute position values with safe single-turn information of series 6FX2001-5.D.-1AA0 with serial DRIVE-CLiQ interface meet the basic requirements of the following standards:

- EN 61508: Part 1-4, SIL 2
- EN ISO 13849-1: 2008, Category 3 PL d
- EN 61800-5-2 (if applicable)

9.2.2 Interface description

9.2.2.1 Overview



Figure 9-20 DRIVE-CLiQ encoder

9.2.2.2 DRIVE-CLiQ interface

Table 9- 22 M12 DRIVE-CLiQ interface, 8-pole A-coded / 8-pin

	Pin	Signal name	Technical data
	1	+ (24 V)	Power supply
	2	Reserved, do not use	-
	3	RXP	Receive data +
	4	RXN	Receive data -
	5	M (0 V)	Electronics ground
	6	TXN	Transmit data -
	7	TXP	Transmit data +
	8	Reserved, do not use	-

9.2.3 Dimension drawings

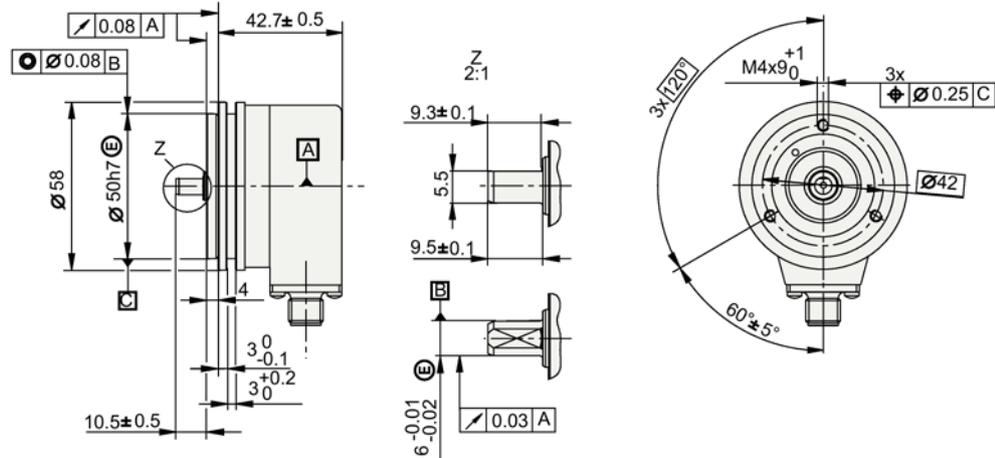


Figure 9-21 Dimension drawing of synchro flange, all data in mm

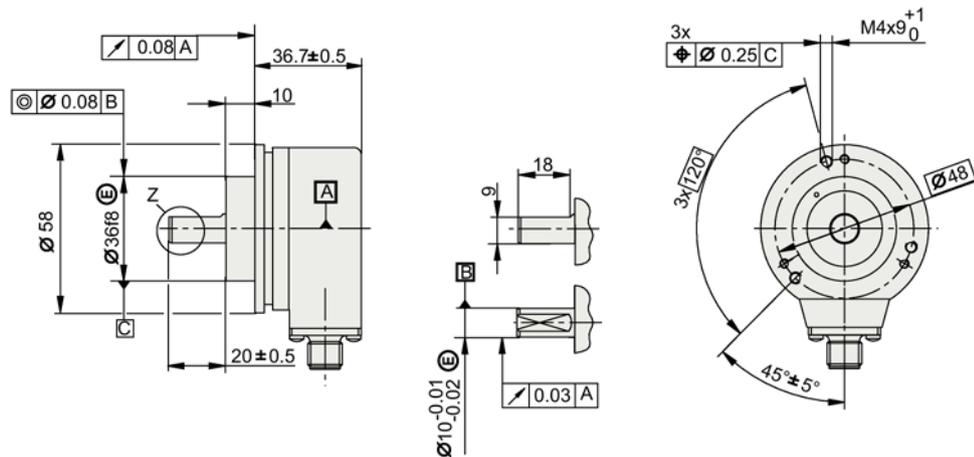


Figure 9-22 Dimension drawing of clamping flange, all data in mm

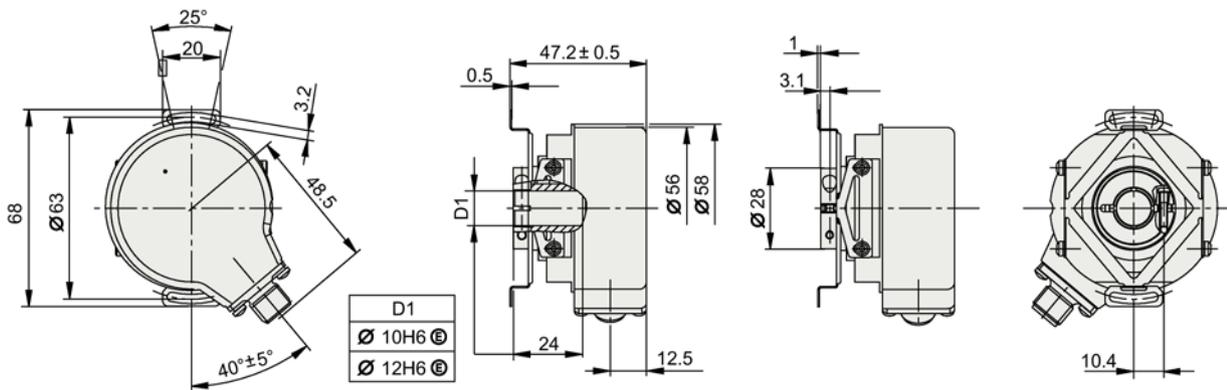


Figure 9-23 Dimension drawing of hollow shaft, all data in mm

9.2.4 Installation

The installation surfaces and screws must be clean and free of grease.

Screw M4 - 8.8 with threadlocker (0.1 < thread friction coefficient < 0.16). Minimum screw-in depth 6 mm. Please observe the hardening time for the threadlocker.

For a permitted surface pressure $P_G \leq 280 \text{ N/mm}^2$, use a washer.

For replacement, recut thread M4 and use new screws with threadlocker.

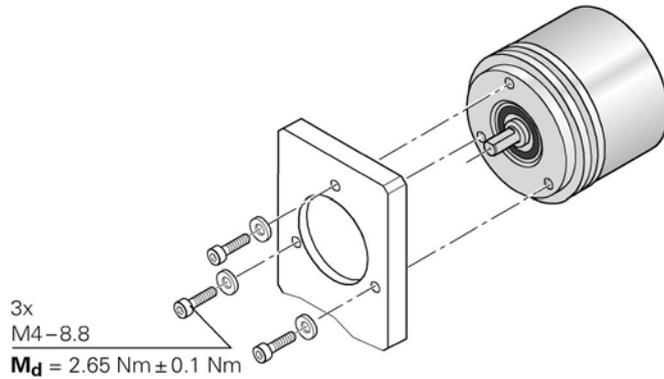


Figure 9-24 Installation: Synchro flange

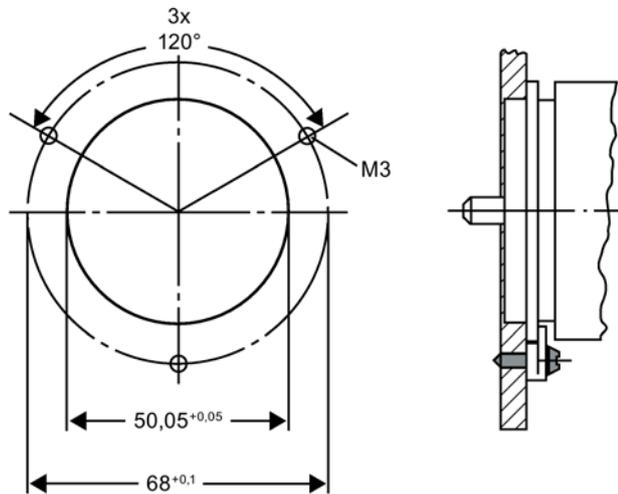


Figure 9-25 Installation with clamp straps

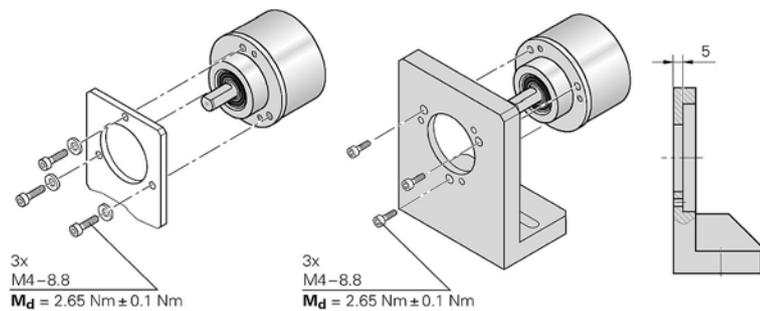


Figure 9-26 Installation: Clamp flange with axial screws

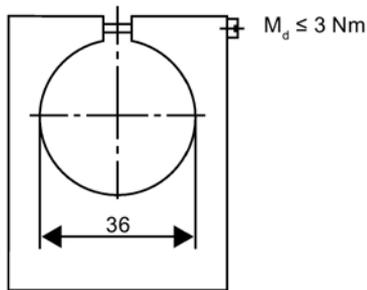


Figure 9-27 Installation: Clamp flange with slotted hole (not suitable for safety-related applications).

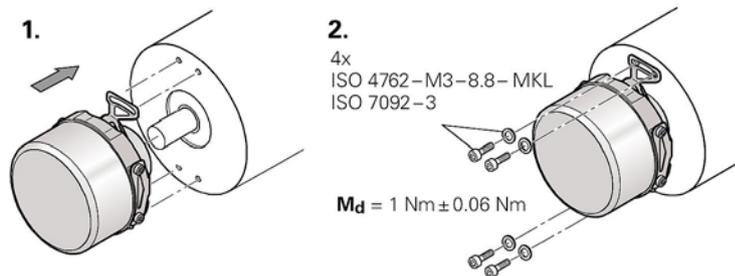


Figure 9-28 Installation: Hollow shaft

Note

Maximum of 4 reuses of screw fastenings

To ensure functional safety, a screw fastening must not be reused more than 4 times.

9.2.4.1 Mounting accessories

Clamp straps and couplings can be supplied as mounting accessories. The clamp straps are used to fix the encoders with a synchronous flange.

Table 9- 23 Selection and ordering data

Designation	Article No.
Clamp strap for encoder synchro flange (3 items are required)	6FX2001-7KP01
Spring disk coupling Shaft diameter:	
• 6 mm / 6 mm	6FX2001-7KF10
• 6 mm / 5 mm	6FX2001-7KF06
Plug-in coupling Shaft diameter:	
• 6 mm / 6 mm	6FX2001-7KS06
• 10 mm / 10 mm	6FX2001-7KS10

Table 9- 24 Installation instructions

Product name	Spring disk coupling	Plug-in coupling
Transmission torque, max.	0.8 Nm (7.1 lbf in)	0.7 Nm (6.2 lbf in)
Shaft diameter	6 mm both ends or d ₁ = 6 mm, d ₂ = 5 mm	6 mm both ends or 10 mm both ends
Center offset of shafts, max.	0.4 mm	0.5 mm
Axial offset	± 0.4 mm	± 0.5 mm
Angular displacement of shafts, max.	3°	1°
Torsional rigidity	150 Nm/rad	31 Nm/rad
Lateral spring stiffness	6 N/mm	10 N/mm
Moment of inertia	19 gcm ²	20 gcm ²
Max. speed	12000 rpm	12000 rpm
Operating temperature	-20 ... +150 °C	-20 ... +80 °C
Weight, approx.	16 g	20 g

9.2.5 Technical data

Table 9- 25 Technical data of DRIVE-CLiQ encoders

Design	Unit	Absolute encoder with DRIVE-CLiQ
Operating voltage at encoder	V	10 ... 28.8
Power consumption Single-turn Multiturn	mA mA	approx. 37 approx. 43
Interface		DRIVE-CLiQ
Transmission rate	Mbit	100
Speed electrically permissible mechanical, max. Single-turn Multiturn	rpm rpm rpm	14000 15000 12000
Cable length , max.	m	100
Connection		Radial flange outlet M12
Resolution Single-turn Multiturn	Bit Bit	24 36 (24-bit single-turn + 12-bit multiturn)
Incremental track	S/R	2048, 1 V _{pp} (encoder internal only)
Code type Transmission		DRIVE-CLiQ
Accuracy	arcsec	±20
Frictional torque	Nm	≤ 0.01 (at 20°C)
Starting torque	Nm	≤ 0.01 (at 20°C)

Design	Unit	Absolute encoder with DRIVE-CLiQ
Shaft load capacity of solid shaft n > 6000 rpm n ≤ 6000 rpm		axial 10 N / radial 20 N at the shaft end axial 40 N / radial 60 N at the shaft end
Shaft diameter Synchro flange Clamp flange Torque arm hollow shaft	mm mm mm	6 with flat 10 with flat 10 or 12
Shaft length Synchro flange Clamp flange	mm mm	10 20
Angular acceleration, max.	rad/s ²	10 ⁵
Moment of inertia of the rotor Solid shaft Hollow shaft	kgm ² kgm ²	2.90 · 10 ⁻⁶ 4.60 · 10 ⁻⁶
Vibration load (55 ... 2000 Hz) Solid shaft Hollow shaft	m/s ² m/s ²	≤ 300 ≤ 150
Shock load (6 ms) Solid shaft Hollow shaft	m/s ² m/s ²	≤ 2000 ≤ 1000
Operating temperature	°C	-30 ... +100
Degree of protection		IP67 at the frame IP64 at the shaft input
Weight Single-turn Multiturn	kg kg	0.35 0.35

9.3 Option module Safe Brake Relay

9.3.1 Description

A Safe Brake Relay is required for operating motors with holding brakes up to 2 A.

The Safe Brake Relay is the interface between the Control Unit/Blocksize Power Modules and the 24 VDC motor brake.

The motor brake is electronically controlled.

The supply voltage for the motor brake must be separately connected to the Safe Brake Relay. A regulated power supply is required, whose rated value (to compensate for the voltage drop in the supply cable for the 24 VDC motor brake coil) can be set to 26 V, e.g. SITOP modular.

Table 9- 26 Interface overview the Safe Brake Relay

Type	Number
Connection for the solenoid of the motor brake	1
Connection for a 24 VDC power supply	1
Connection for the pre-fabricated (CTRL) to the Power Module, Blocksize format	1

The Safe Brake Relay is supplied with the pre-fabricated cable to connect to the Power Module and all of the customer connectors.

9.3.2 Safety instructions for Safe Brake Relays

Note

A regulated DC power supply is required to operate motors with a built-in holding brake. The voltage is supplied via the internal 24 V busbars. The voltage tolerances of the motor holding brakes and the voltage losses of the connection cables must be observed.

- Set the DC power supply to 26 V. This ensures that the power supply for the brake remains within the permissible range when the following conditions are met:
 - Use of Siemens three-phase motors
 - Use of Siemens MOTION-CONNECT power cables
 - Motor cable lengths: max. 100 m
-

9.3.3 Interface description

9.3.3.1 Overview

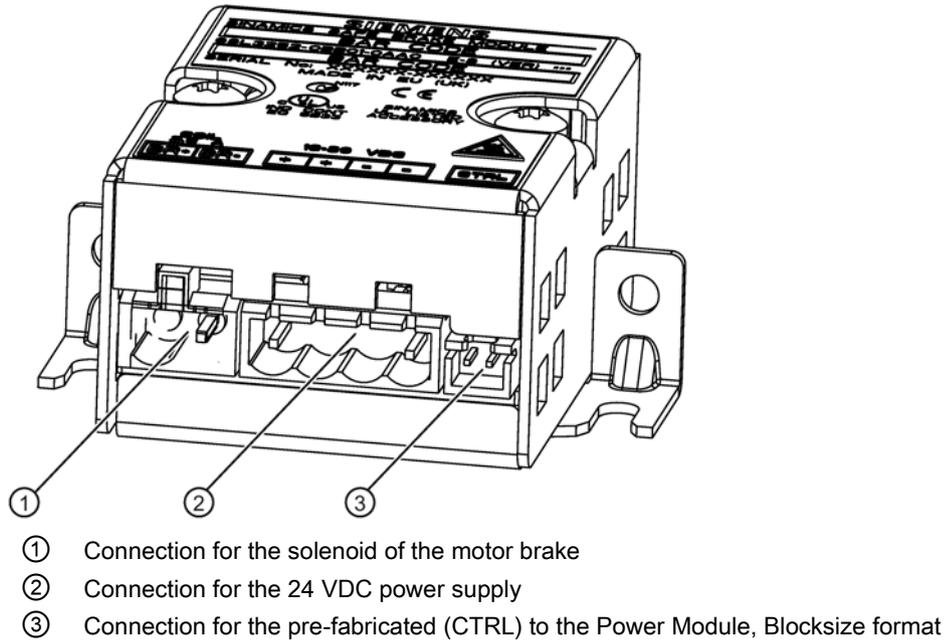


Figure 9-29 Interface description: Safe Brake Relay

9.3.3.2 X524 electronics power supply

Table 9- 27 X524 electronics power supply

	Terminal	Function	Technical data
	+	Electronics power supply	Voltage: 24 V (20.4 ... 28.8 V) Current consumption: max. 0.3 A (without motor holding brake)
	+	Electronics power supply	
	GND	Electronics ground	Maximum current via jumper in connector: 20 A (15 A according to UL/CSA)
	GND	Electronics ground	
Type: Screw-type terminal 2 (Page 384) Max. cross-section that can be connected: 2.5 mm ² (AWG 14)			

The maximum cable length that can be connected is 30 m.

Note

The two "+" and/or "M" terminals are jumpered in the connector. This ensures that the supply voltage is looped through.

9.3.3.3 Brake connection

Table 9- 28 Connector

Designation	Technical data
Brake connection	Relay output (close)
Protective conductor connection	M4 / 3 Nm (26.6 lbf in)

9.3.4 Connection example

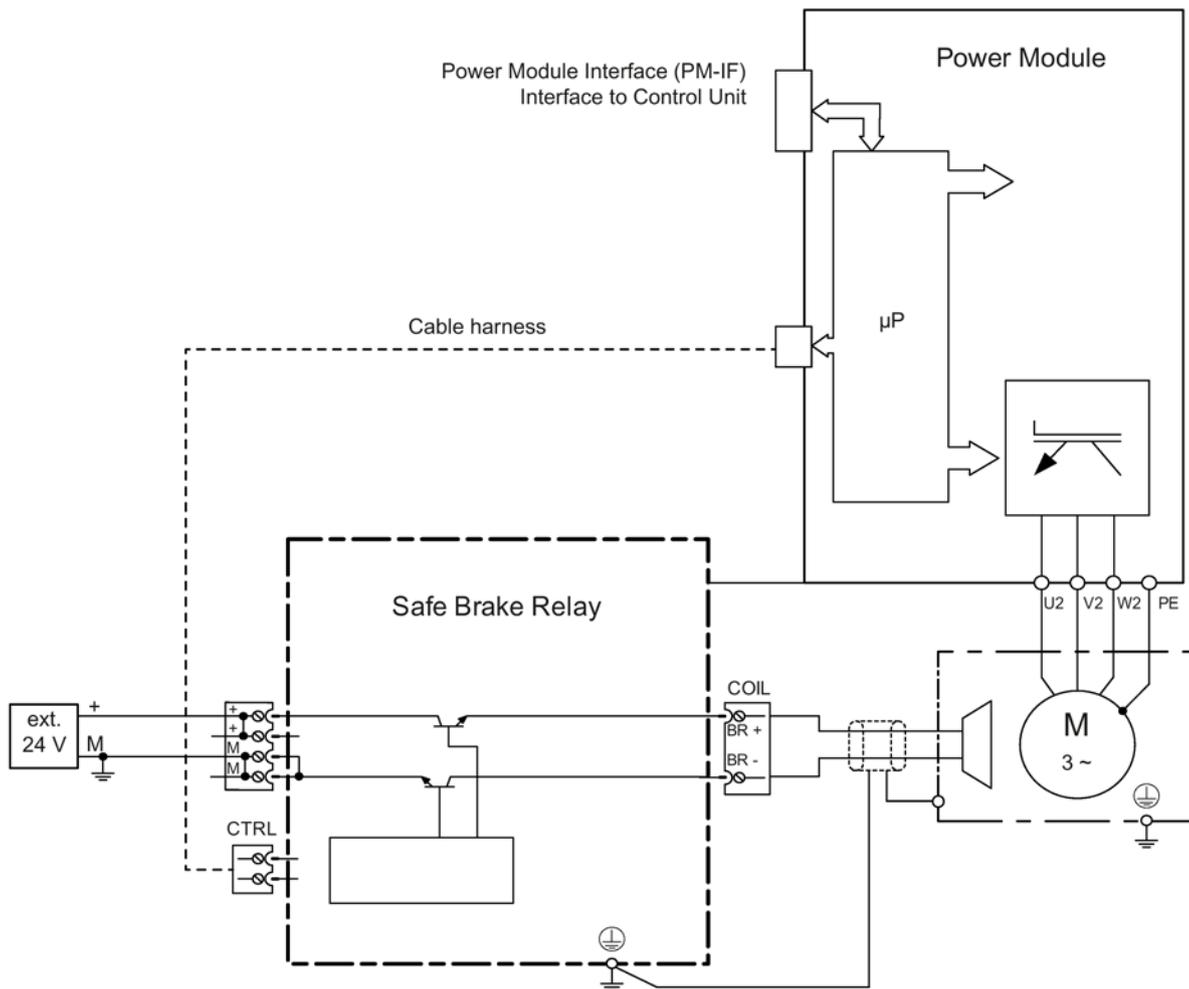


Figure 9-30 Safe Brake Relay connection example

9.3.5 Dimension drawing

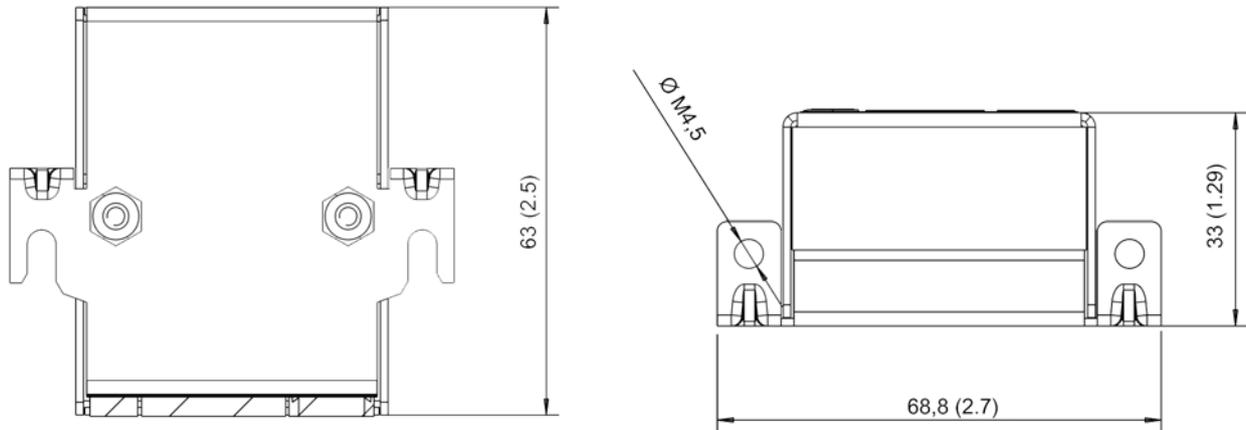


Figure 9-31 Dimension drawing of Safe Brake Relay, all data in mm and (inches)

9.3.6 Mounting

PM240-2 FSA to FSC Power Modules

- Mount the Safe Brake Relay at the rear of the cabinet next to the Power Module.

PM240-2 Power Modules, FSD to FSG

- Mount the Safe Brake Relay at the rear of the lower shield plate.
- Attach the Safe Brake Relay before you install the shield plate.

9.3.7 Technical data

Table 9- 29 Technical data

6SL3252-0BB01-0AA0	Unit	
Power supply	V _{DC}	20.4 ... 28.8 Recommended nominal value of the power supply 26 V DC (to equalize and compensate for the voltage drop along the feeder cable to the 24 V DC solenoid of the motor brake)
Current requirement, max.		
Motor brake	A	2
at 24 V DC	A	0.05 + current requirement of the motor brake
Switching cycles, max.		Basically unlimited ¹⁾
Conductor cross section, max.		2.5 mm ² (AWG 14)
Dimensions (W x H x D)	mm	69 x 63 x 33
Weight	kg	approx. 0.17

¹⁾ Mechanical switching elements are not subject to wear in the case of solid-state relays.

9.4 Safe Brake Adapter optional module

9.4.1 Description

The Safe Brake Adapter (SBA) is required to implement Safe Brake Control (SBC) in conjunction with Power Modules in the chassis format.

The Safe Brake Control (SBC) is a safety function, that is used in safety-related applications, e.g. in presses or in rolling mills. In the no-current state, the brake acts on the motor of the drive using spring force. The brake is released (opened) when current flows through it (=low active).

Power must be connected to terminal X12 on the Safe Brake Adapter.

For controlling the brake, a connection must be established between terminal X14 on the Safe Brake Adapter and the motor holding brake.

For the control, a connection must be established between the Safe Brake Adapter and the Control Interface Module.

The cable harness with article number 6SL3060-4DX04-0AA0 can be used.

Fast de-energization

In some cases, DC brakes are operated with an upstream brake rectifier (230 VAC input side) for fast de-energization. Some brake rectifiers are equipped with two additional connections for switching the brake load on the DC side. This allows the brake coil to be quickly de-energized, i.e. braking starts earlier.

The Safe Brake Adapter supports such fast de-energization via the two additional connections for X15.1 and X15.2. This function does not belong to safe brake control.

Note

Determination of the time until the brake engages without fast de-energization

As the fast de-energization is not part of the safety function, this functionality is not monitored. The fast de-energization can therefore fail during operation without being noticed. Therefore, to determine the time until the brake engages for a machine acceptance, the fast de-energization must be bypassed by short-circuiting the terminals at X15.1 and X15.2.

9.4.2 Safety instructions for Safe Brake Adapters

 WARNING**Danger to life when enabling the motor brake with a damaged connecting cable**

If the connection cable between the Safe Brake Adapter and the motor brake is broken or short circuited, this may result in the motor brake being supplied with power and released. If the motor cannot be braked, death or serious injury may result.

- Test the motor brake by means of the Safety Integrated Extended Function "Safe Brake Test."

NOTICE**Damage to the Safe Brake Adapter when connecting a 24 V DC brake**

If a 24 V DC brake is connected to the 230 V AC Safe Brake Adapter on the system side, this may cause damage to the Safe Brake Adapter. This can result in the following undesirable effects:

- Closing the brake is not displayed on the LEDS.
- The fuse is tripped.
- The contact service life of the relay is reduced.
- Do not connect a 24 V DC brake to the 230 V AC Safe Brake Adapter on the system side.

Note

The integrated safety functions, starting from the Safety Integrated (SI) input terminals of the SINAMICS components (Control Unit, Motor Module), satisfy the requirements according to EN 61800-5-2, EN 60204-1, DIN EN ISO 13849-1 Category 3 (formerly EN 954-1) for Performance Level (PL) d and IEC 61508 SIL2.

With the Safe Brake Adapter, the requirements specified in EN 61800-5-2, EN 60204-1, DIN EN ISO 13849-1 Category 3 (formerly EN954-1) as well as for Performance Level (PL) d and IEC 61508 SIL 2 are fulfilled.

9.4.3 Interface description

9.4.3.1 Overview

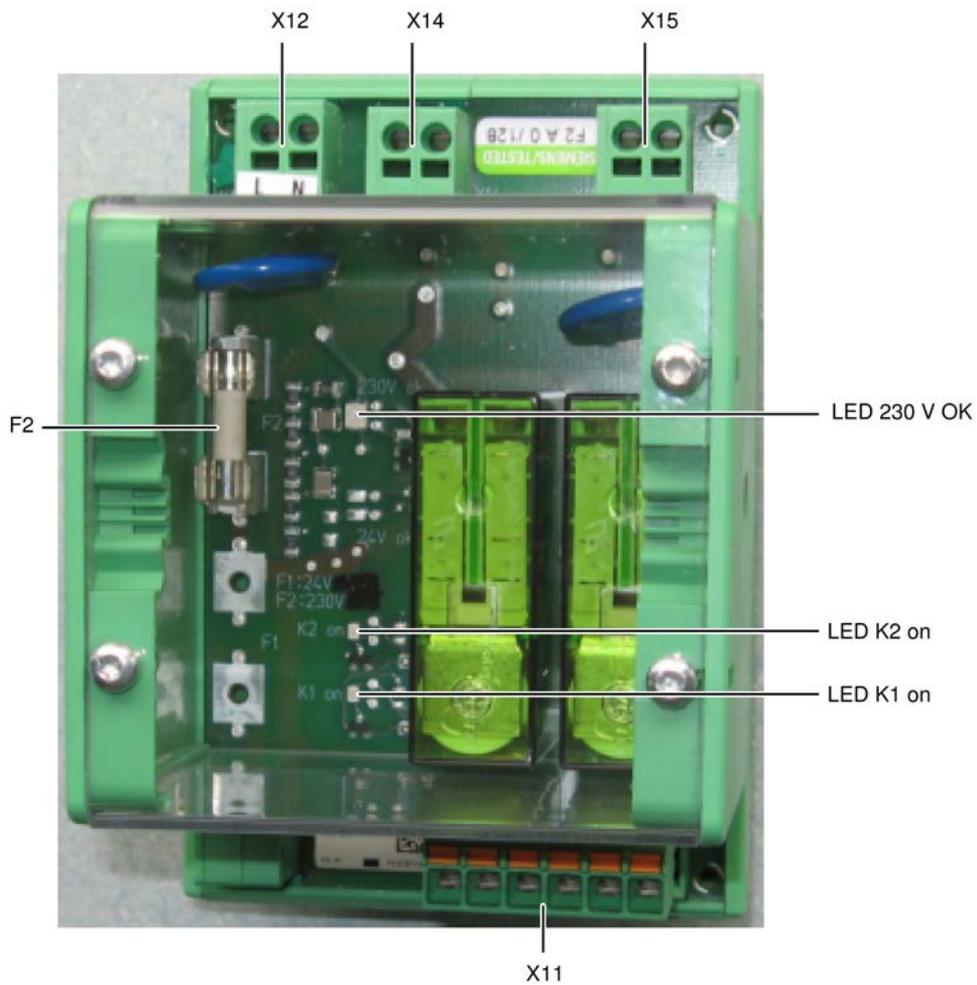


Figure 9-32 Interface overview, Safe Brake Adapter 230 VAC

F2 fuse

Type of spare fuse: 2 A, time-lag

9.4.3.2 X11 interface to the Control Interface Module

Table 9- 30 X11 interface to the Control Interface Module

Terminal	Signal	Description	Technical data
X11.1	BR+	Control channel 1	Connection to Control Interface Board, X46.1
X11.2	BR-	Control channel 2	Connection to Control Interface Board, X46.2
X11.3	FB+	Relay feedback signal	Connection to Control Interface Board, X46.3
X11.4	FB-	Ground of the relay feedback signal	Connection to Control Interface Board, X46.4
X11.5	P24	P24 of the auxiliary voltage to supply the feedback signal	Connection to Control Interface Board, X42.2
X11.6	M	Ground of the auxiliary voltage	Connection to Control Interface Board, X42.3
Max. connectable cross-section: 2.5 mm ² (AWG 14)			

 WARNING
<p>Fire due to overheating resulting from excessively long connecting cables</p> <p>Excessively long power cables can cause overheating of components with resulting fire and smoke development.</p> <ul style="list-style-type: none"> The maximum permissible cable length of 10 m between the 230 V AC Safe Brake Adapter and the Control Interface module must not be exceeded. <p>Use cable harness (length: 4 m) with article number 6SL3060-4DX04-0AA0.</p>

9.4.3.3 X12 230 V AC power supply

Table 9- 31 X12 230 V AC power supply

Terminal	Signal	Technical data
X12.1	L	Supply voltage: AC 230 V
X12.2	N	Current consumption: 2 A, protection according to IEC 60269-1, operating class gG
Max. connectable cross-section: 2.5 mm ² (AWG 14)		

9.4.3.4 X14 load connection

Table 9- 32 X14 load connection

Terminal	Signal	Technical data
X14.1	BR L	Supply voltage: AC 230 V
X14.2	BR N	Current consumption: 2 A, only for brakes with brake rectifier
Max. connectable cross-section: 2.5 mm ² (AWG 14)		

 WARNING
<p>Fire due to overheating resulting from excessively long connecting cables</p> <p>Excessively long power cables can cause overheating of components with resulting fire and smoke development.</p> <ul style="list-style-type: none"> The maximum permissible cable length of 300 m between the Safe Brake Adapter 230 V AC and the brake must not be exceeded. <p>Information for precise calculation of the maximum cable length can be found in the Configuration Manual: SINAMICS-Low Voltage.</p>

9.4.3.5 X15 fast de-energization

Table 9- 33 X15 fast de-energization

Terminal	Signal	Technical data
X15.1	AUX 1	Supply voltage: AC 230 V
X15.2	AUX 2	Current consumption
Max. connectable cross-section: 2.5 mm ² (AWG 14)		

9.4.4 Connection example

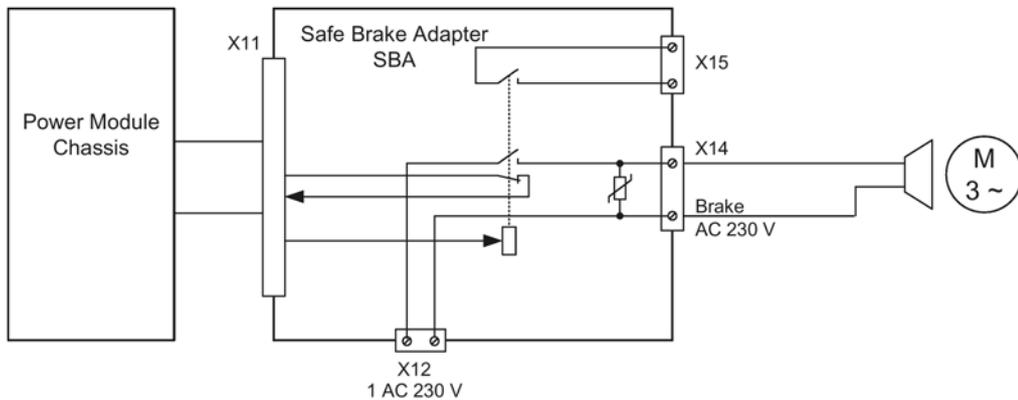


Figure 9-33 Connection example for a Safe Brake Adapter

9.4.5 Dimension drawing

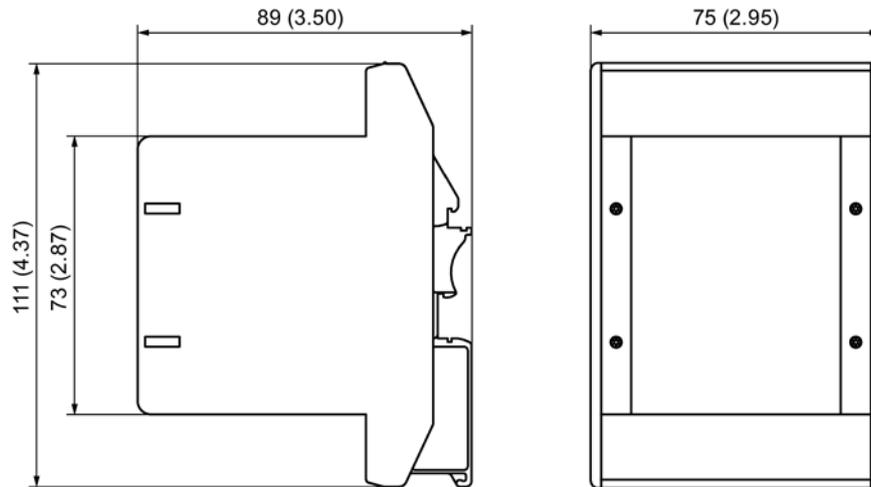


Figure 9-34 Dimension drawing of Safe Brake Adapter, all data in mm and (inches)

9.4.6 Mounting

Safe Brake Adapter

The Safe Brake Adapter is designed for mounting on a rail in accordance with EN 60715

Housing cover after replacing the fuse

An adhesive label is provided on the housing cover indicating the position of the connector. You should attach the housing cover so that the labeling on the label matches the connectors.

9.4.7 Technical data

Table 9- 34 Technical data

6SL3355-2DX00-1AA0	Unit	Value
Electronics power supply (power supply via the Control Interface Module)	V _{DC}	24 (20.4 ... 28.8)
Power supply Motor holding brake	V _{AC}	230
Current consumption, max. Motor holding brake	A	2
Fast de-energization	A	2
Weight	kg	0.25

Accessories

10.1 DRIVE-CLiQ cabinet bushings

10.1.1 Description

A DRIVE-CLiQ cabinet bushing is used to connect the DRIVE-CLiQ cables between the inside and outside of the control cabinet. It is used in a control cabinet panel. The data lines and the voltage supply contacts of the DRIVE-CLiQ are also routed through the bushing. The DRIVE-CLiQ cabinet bushing is available for DRIVE-CLiQ cables with RJ45 connector and M12 plug/socket.

DRIVE-CLiQ cabinet bushing for RJ45 connector

The cabinet bushing has degree of protection IP54 according to IEC 60529 from the outside towards the inside. Inside the control cabinet, a connection is established according to degree of protection IP20 or IPXXB acc. to IEC 60529. So that the complete outside of the cabinet bushing, including the DRIVE-CLiQ interface, has degree of protection IP54, a DRIVE-CLiQ cable must be used, which as a minimum must also have degree of protection IP54.

DRIVE-CLiQ cabinet bushing for M12 connector/socket

The cabinet bushing has degree of protection IP67 according to IEC 60529 from the outside towards the inside. Inside the cabinet a connection according to degree of protection IP67 in compliance with IEC 60529 is realized.

NOTICE

Damage through use of incorrect DRIVE-CLiQ cables

Damage or malfunctions can occur on the devices or system when incorrect or unreleased DRIVE-CLiQ cables are used.

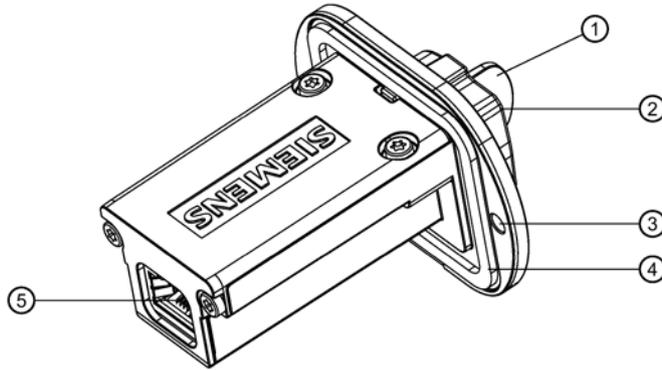
- Only use suitable DRIVE-CLiQ cables that have been released by Siemens for the respective application.

10.1 DRIVE-CLiQ cabinet bushings

10.1.2 Interface description

10.1.2.1 Overview

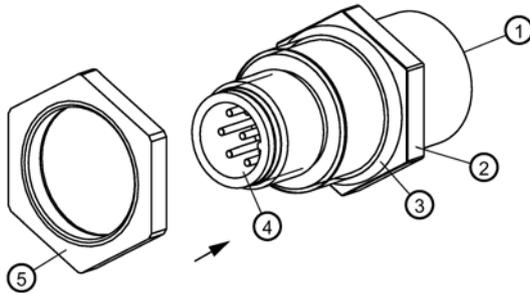
DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables with RJ45 connector



- ① Protective cap, Yamaichi, Article No.: Y-ConAS-24-S
- ② DRIVE-CLiQ interface on the outside (to connect DRIVE-CLiQ signal cables MOTION-CONNECT with IP67 degree of protection)
- ③ Mounting holes
- ④ Flange-type seal to ensure degree of protection IP54 on the outside of the cabinet
- ⑤ DRIVE-CLiQ interface on the inside (to connect DRIVE-CLiQ signal cables MOTION-CONNECT with IP20 degree of protection)

Figure 10-1 Interface overview, DRIVE-CLiQ cabinet bushing

DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ cables with M12 plug/socket



- ① DRIVE-CLiQ interface with M12 socket (8-pin)
- ② Flange, SW18
- ③ Seal
- ④ DRIVE-CLiQ interface with M12 plug (8-pin)
- ⑤ O ring, SW20, tightening torque: 3 ... 4 Nm (26.6 ... 35.4 lbf in)

Figure 10-2 Interface overview, DRIVE-CLiQ cabinet bushing M12

10.1.3 Dimension drawings

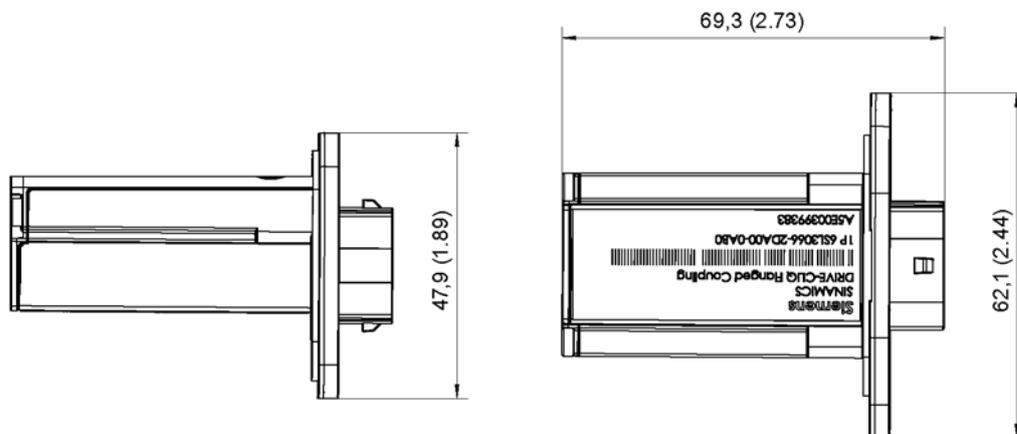
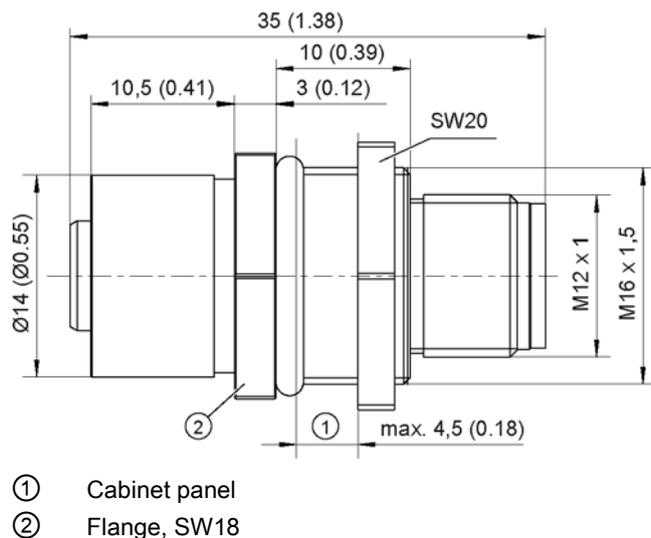


Figure 10-3 Dimension drawing of the DRIVE-CLiQ cabinet gland, all dimensions in mm and (inches)



- ① Cabinet panel
- ② Flange, SW18

Figure 10-4 Dimension drawing of the DRIVE-CLiQ cabinet bushing M12, all dimensions in mm and (inches)

10.1.4 Installation

10.1.4.1 DRIVE-CLiQ cabinet bushing for cables with DRIVE-CLiQ connectors

In order to install the DRIVE-CLiQ cabinet gland, you must make a cutout in the control cabinet panel as shown in the diagram below.

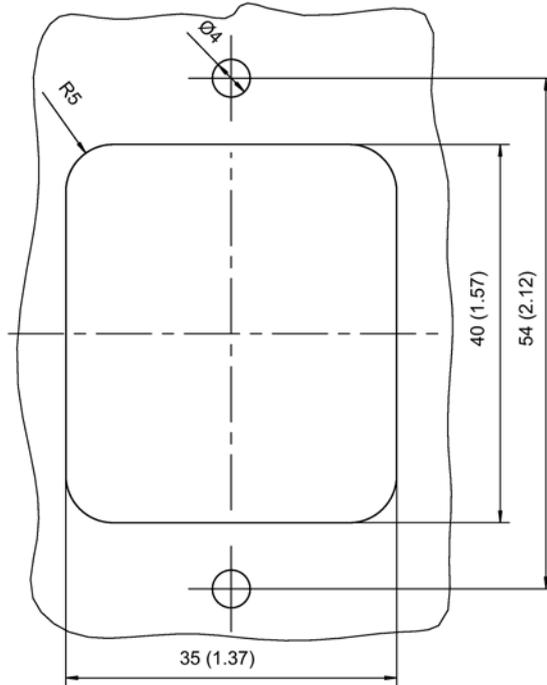
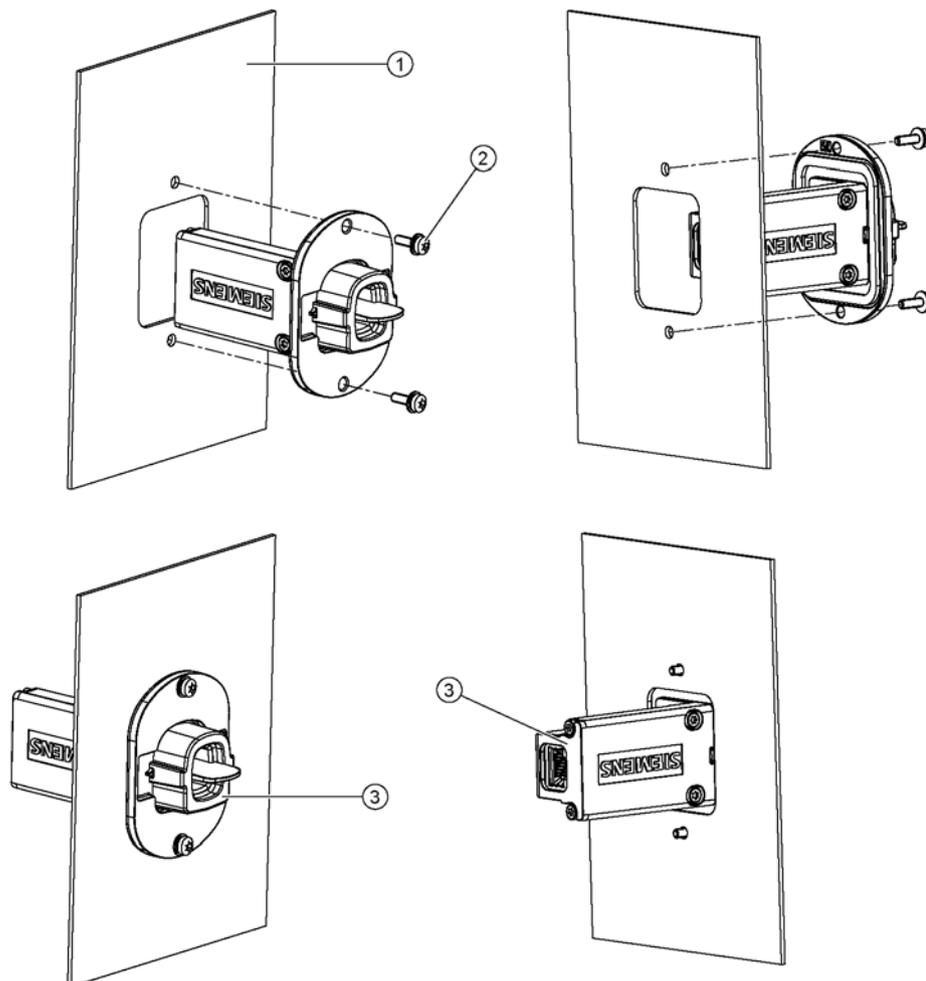


Figure 10-5 Cutout in the control cabinet, all dimensions in mm and (inches)

1. Insert the DRIVE-CLiQ cabinet bushing from the outside of the control cabinet through the cutout in the control cabinet.
2. Attach the DRIVE-CLiQ cabinet bushing to the outer control cabinet panel using 2 M3 screws and 2 nuts. In order to ensure good electromagnetic compatibility, a good electrical connection must be established between the DRIVE-CLiQ cabinet gland and the cabinet panel over a large surface area.



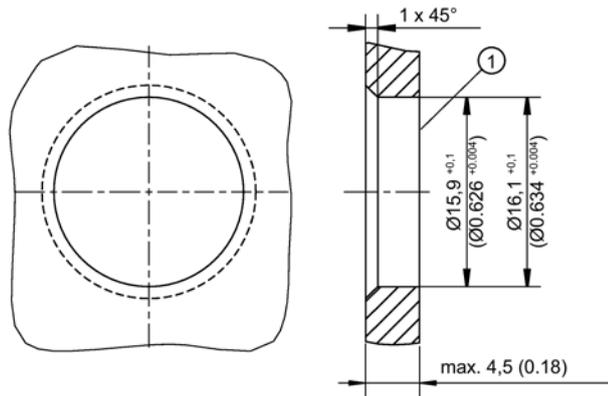
- ① Control cabinet panel
- ② Screw M3, tightening torque 0.8 Nm (7.1 lbf in)
- ③ DRIVE-CLiQ cabinet bushing

Figure 10-6 Mounting the DRIVE-CLiQ cabinet bushing for cables with RJ45 connector

10.1.4.2 DRIVE-CLiQ cabinet bushing for cables with M12 plug/socket

Prepare the cabinet panel for mounting the DRIVE-CLiQ cabinet bushing M12 as shown below. The removable O ring can be screwed from the inside or the outside.

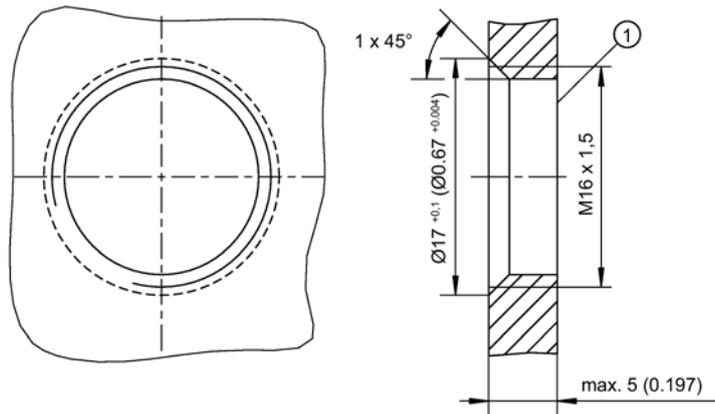
Mounting from the inside using an O ring that can be screwed



① Through-hole with chamfer

Figure 10-7 Through-hole for mounting the DRIVE-CLiQ cabinet bushing M12 with an O-ring that can be screwed from the inside

Mounting from the outside using an O ring that can be screwed

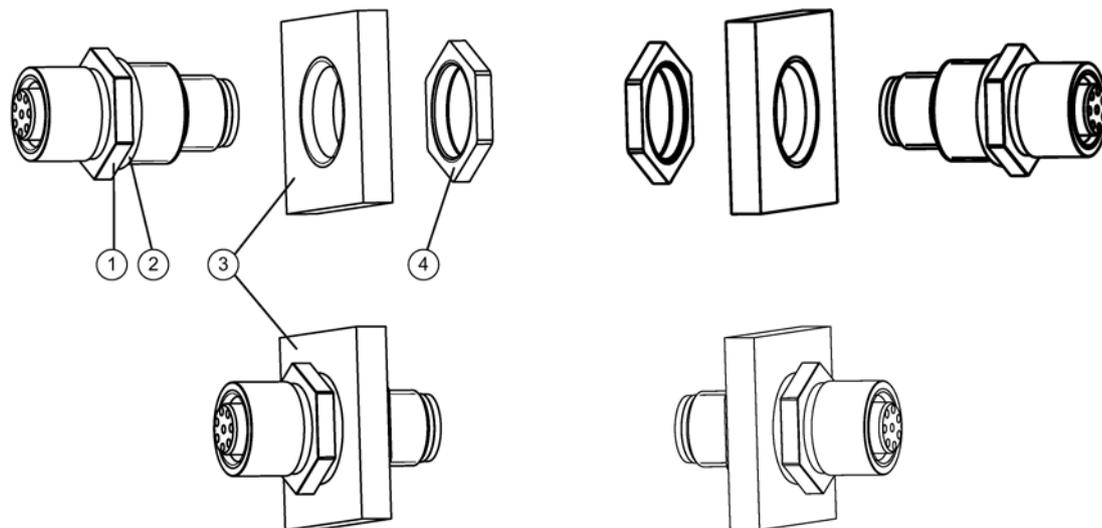


① Threaded hole with chamfer

Figure 10-8 Threaded hole for mounting the DRIVE-CLiQ cabinet bushing M12 with an O-ring that can be screwed from the outside

Mounting

1. Insert the DRIVE-CLiQ cabinet bushing through the opening in the cabinet.
2. Fasten the DRIVE-CLiQ cabinet bushing using the associated O ring with a tightening torque of 3 - 4 Nm (26.6 ... 35.4 lbf in).



- ① Flange, SW18
- ② Seal
- ③ Cabinet panel
- ④ O ring, SW20, tightening torque: 3 ... 4 Nm (26.6 ... 35.4 lbf in)

Figure 10-9 Mounting DRIVE-CLiQ cabinet bushings for cables with M12 connectors

10.1.5 Technical data

Table 10- 1 Technical data of DRIVE-CLiQ cabinet bushings

	Unit	6SL3066-2DA00-0AA0 DRIVE-CLiQ	6FX2003-0DT67 M12
Weight	kg	0.165	0.035
Degree of protection to IEC 60529		IP54 outside the control cabinet IP20 or IPXXB inside the control cabinet	IP67

10.2 DRIVE-CLiQ coupling

10.2.1 Description

The DRIVE-CLiQ coupling is used to connect 2 DRIVE-CLiQ cables in accordance with degree of protection IP67 acc. to IEC 60529.

In addition to the data lines, the power supply contacts of DRIVE-CLiQ are also routed via the coupling.

You can find information on the permissible cable length in Chapter DRIVE-CLiQ signal cables (Page 377)

NOTICE

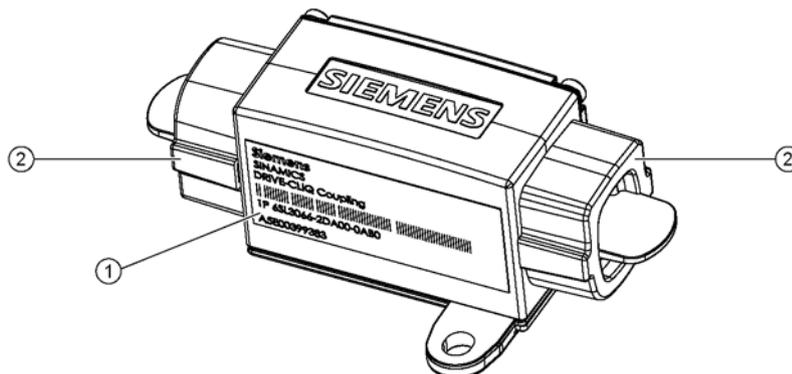
Damage through use of incorrect DRIVE-CLiQ cables

Damage or malfunctions can occur on the devices or system when incorrect or unreleased DRIVE-CLiQ cables are used.

- Only use suitable DRIVE-CLiQ cables that have been released by Siemens for the respective application.

10.2.2 Interface description

10.2.2.1 Overview



- ① Rating plate
- ② Protective cap, Yamaichi, Article No.: Y-ConAS-24-S

Figure 10-10 Interface overview, DRIVE-CLiQ coupling

10.2.3 Dimension drawing

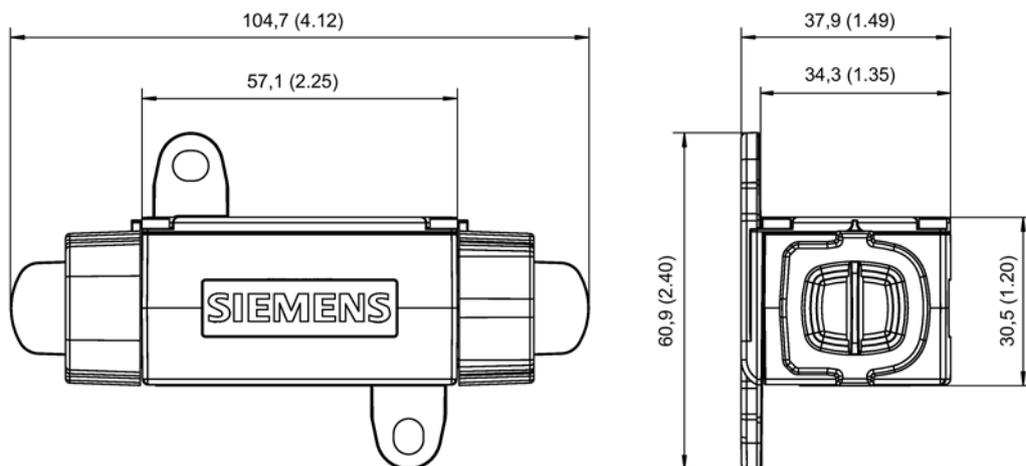
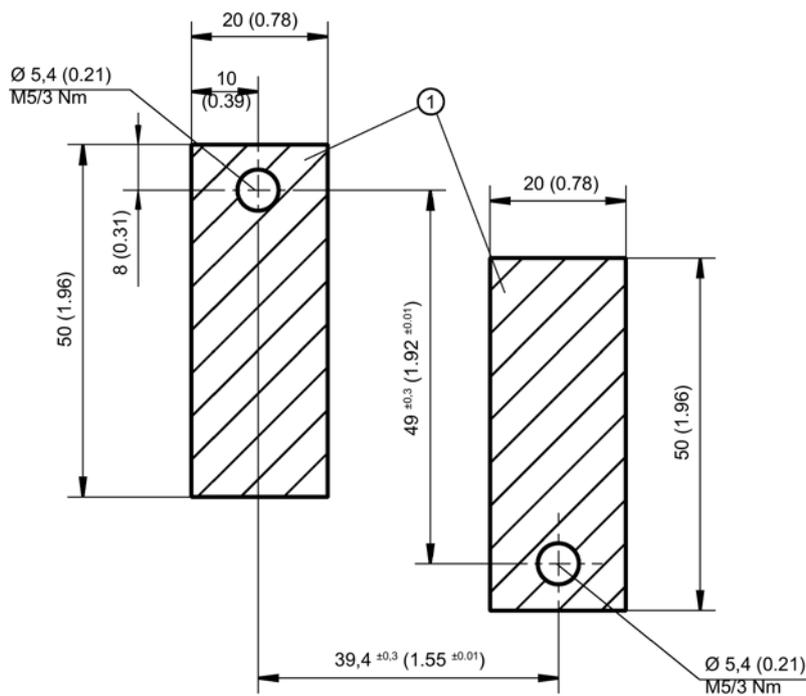


Figure 10-11 Dimension drawing of the DRIVE-CLiQ coupling, all dimensions in mm and (inches)

10.2.4 Mounting



① Contact surface

Figure 10-12 Hole drilling pattern for installation

Installation

1. Attach the DRIVE-CLiQ coupling to the mounting surface as shown in the drilling pattern.
2. Remove the protective caps of the DRIVE-CLiQ coupling.
3. Latch the RJ45 connectors on both ends of the DRIVE-CLiQ coupling.

10.2.5 Technical data

Table 10- 2 Technical data

DRIVE-CLiQ coupling 6SL3066-2DA00-0AB0	Unit	
Weight	kg	0.272
Degree of protection	IP67 according to IEC 60529	

10.3 Mounting frame

10.3.1 Description

With the use and proper installation of Siemens mounting frames, the push through Power Modules achieve degree of protection IP54.

Article Nos.

- FSA: 6SL3260-6AA00-0DA0
- FSB: 6SL3260-6AB00-0DA0
- FSC: 6SL3260-6AC00-0DA0
- FSD: 6SL3200-0SM17-0AA0
- FSE: 6SL3200-0SM18-0AA0
- FSF: 6SL3200-0SM20-0AA0

The accessories package contains all the necessary nuts and seals.

10.3.2 Dimension drawings

Dimension drawings of mounting frame, frame sizes FSA to FSF

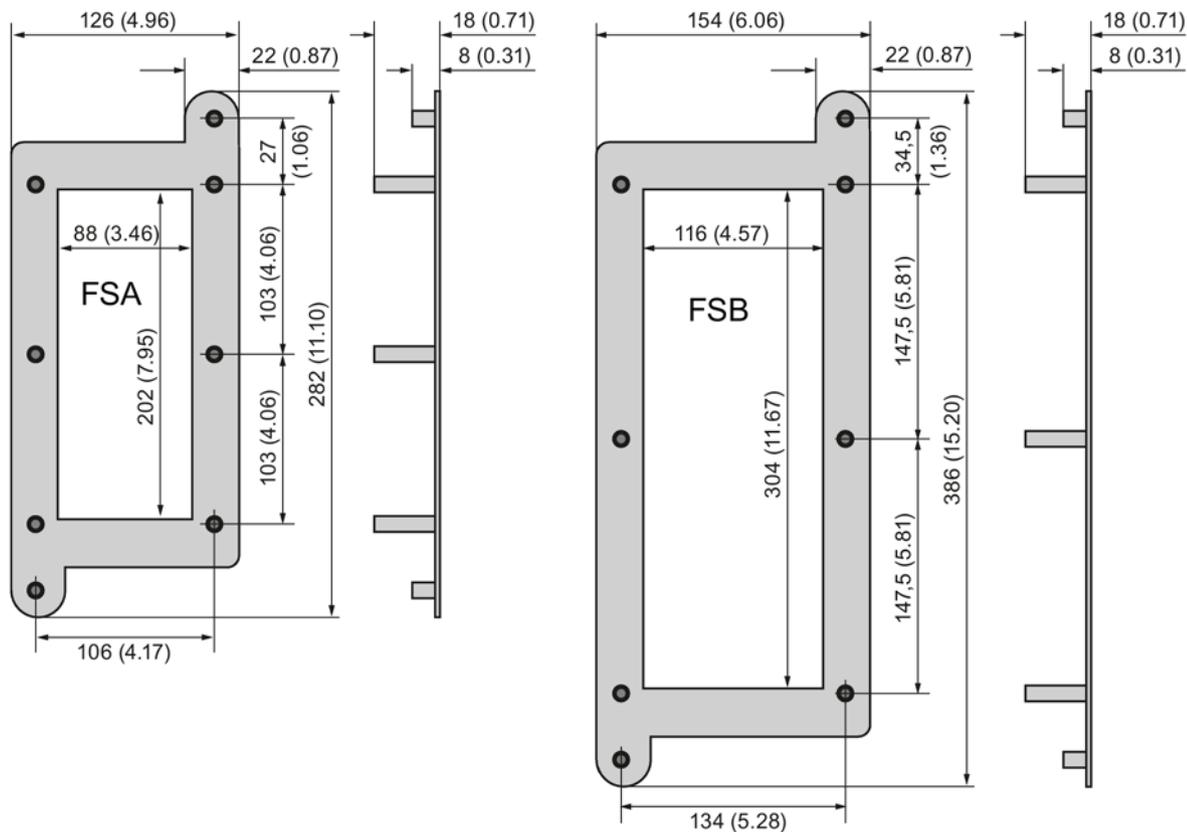


Figure 10-13 Dimension drawing of mounting frame, frame size FSA and FSB, all data in mm and (inches)

10.3 Mounting frame

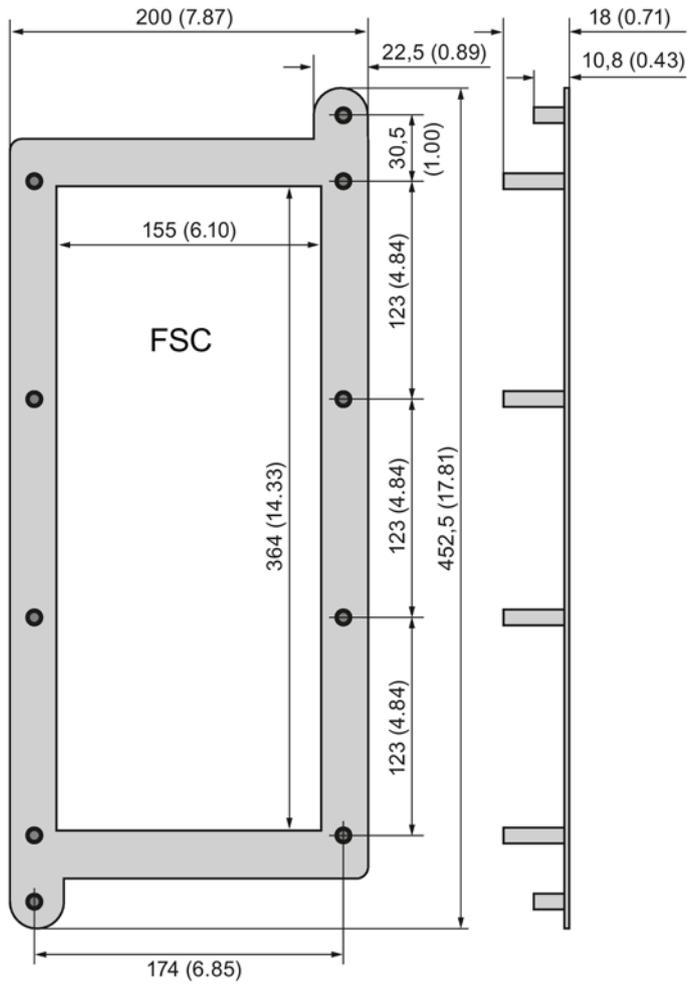


Figure 10-14 Dimension drawing of mounting frame, frame size FSC, all data in mm and (inches)

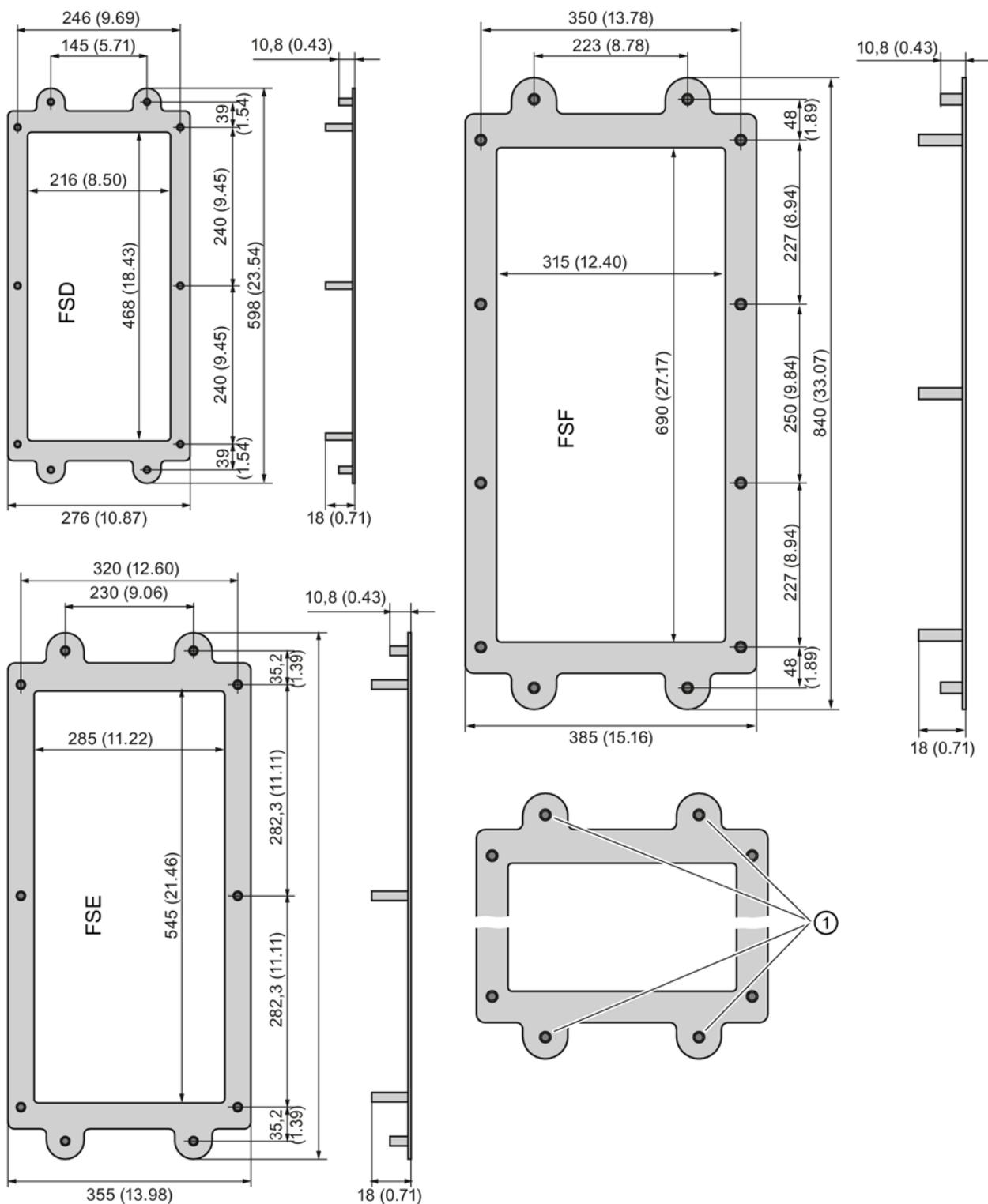


Figure 10-15 Dimension drawing of mounting frame, frame sizes FSD to FSF, all data in mm and (inches)

10.3.3 Mounting

Note

Compliance with the EMC requirements

To meet the EMC requirements, make sure the contact surface of the heat sink is free of any paint.

Installation steps

1. Make an installation cutout and drill holes for the Power Module and the mounting frame according to the drilling pattern.
2. Fasten the mounting frame to the outer wall of the cabinet. Tighten the 2 screws finger-tight.
3. Attach the seal to the inner side of the cabinet.
4. Fasten the Power Module. Tighten the screws finger-tight.
5. Tighten all screws with a torque of 3.5 Nm (31.0 lbf in).

10.4 Mounting handles for Power Modules push through

Mounting handles can be ordered for push-through power modules, frame sizes FSD ... FSF
The mounting grips allow the Power Module to be installed without using hoisting gear.

Install the four lifting grips as shown in the following image.

Article No.: 6SL3200-0SM22-0AA0

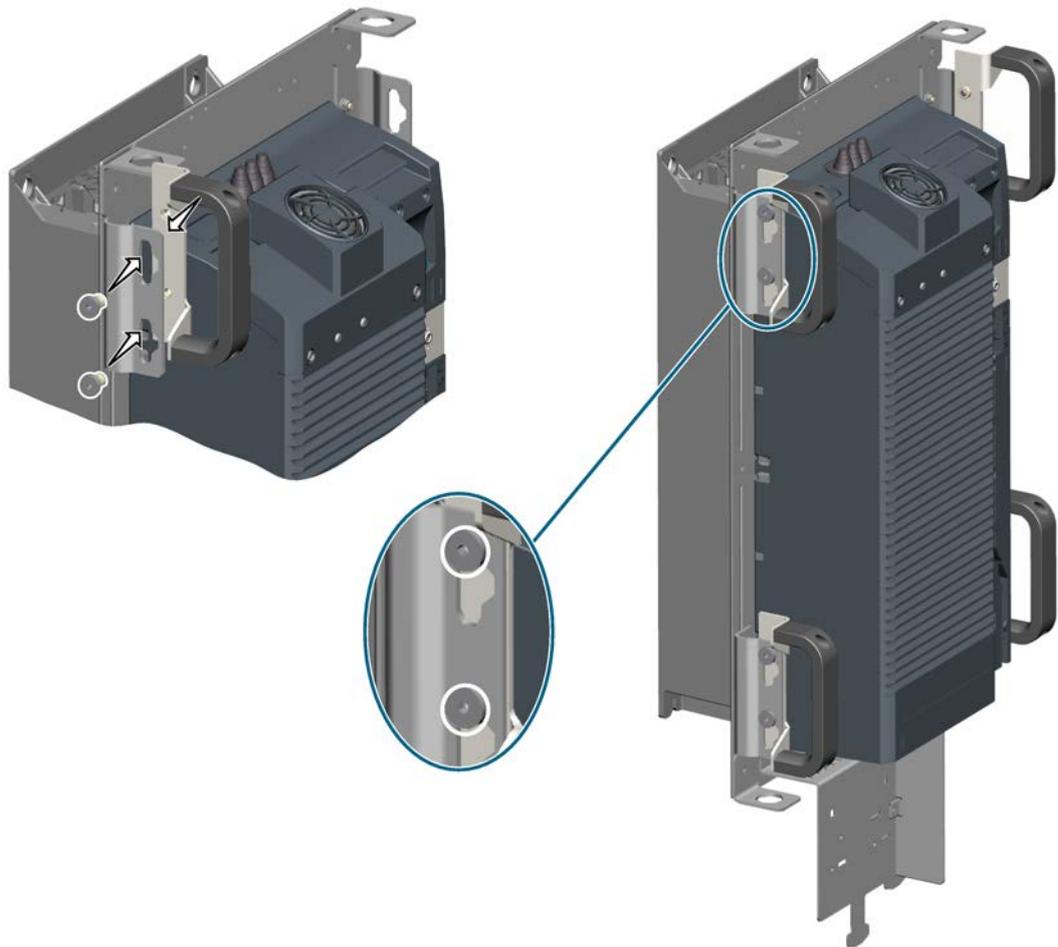


Figure 10-16 Mounting handles for Power Modules push through FSD-FSF

10.4 Mounting handles for Power Modules push through

11.1 General information

SINAMICS S components are available as chassis units with degree of protection IP20 or IPXXB according to IEC 60529 and as open type devices to UL 50. This therefore ensures that fingers cannot come into contact with any live parts.

To ensure also protection against mechanical stress and climatic conditions, the components must always be operated in housings, cabinets or enclosed electrical operating areas/rooms that fulfill at least degree of protection IP54 according to European enclosure specifications, or in compliance with US, Canadian and Mexican regulations as enclosure type 12, according to NEMA 250.

Note

Protection against the spread of fire

The Power Module may be operated only in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used.

Power Modules of the open type/IP20 degree of protection must be installed in a metal control cabinet or protected by another equivalent measure such that fire cannot spread and emissions outside of the control cabinet are prevented.

Note

Protection against condensation and electrically conductive contamination

To ensure the functional safety and safety functions of Safety Integrated, protect the Power Module, e.g. by installing it in a control cabinet with degree of protection IP54 according to IEC 60529 or Type 12 according to NEMA 250. Further measures may be necessary for particularly critical operating conditions.

If condensation and conductive pollution can be excluded at the installation site, a lower degree of cabinet protection is permissible.

Low-voltage switchgear and controlgear assemblies

If the SINAMICS S drive line-up is used for the electrical equipment of machines, the applicable requirements of EN 60204-1 must also be adhered to.

Safety of machinery - electrical equipment of machines

All information relating to device selection in this section applies to

- Operation on TN and TT line supply systems with grounded neutral point and grounded protective conductor as well as on IT line supply systems
- Operating voltage range from 1/3 AC 200 V to 3 AC 690 V

11.2 Safety instructions for control panel manufacturing



WARNING

Electric shock caused by high leakage currents when the protective conductor in the line feeder cable is interrupted

Drive components conduct high discharge currents via the protective conductor. Touching conductive parts when the protective conductor is interrupted can result in death or serious injury.

- Carefully comply with the applicable regulations when dimensioning the protective conductor (Page 385).



WARNING

Electric shock due to incorrectly routed brake cables

When routing brake cables without safe electrical separation, the insulation can fail resulting in electric shock.

- Connect the holding brake using the MOTION-CONNECT cable intended for the purpose.
- Only use third-party cables that have brake cores with safe electrical separation or separately route the brake cores with safe electrical separation.

WARNING

Fire due to overheating resulting from excessively long connecting cables

Excessively long power cables can cause overheating of components with resulting fire and smoke development.

- The cable lengths (e.g. motor cable, DC-link cable) listed in the technical data must not be exceeded.

WARNING

Danger of injury caused by foreign objects in the device

Parts (e.g. drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can lead to serious injuries (arcing, bang, pieces flying out of the equipment).

- Only perform installation and other work when the devices are current-free.
- Cover the ventilation slits during the installation of the cabinet and remove the cover before switching on.

NOTICE

Damage due to use of incorrect coupling or cabinet bushings on DRIVE-CLiQ connections

Damage or malfunctions can occur on the devices or system if incorrect or unreleased couplings or cabinet bushings on DRIVE-CLiQ connections are used.

- Only use the DRIVE-CLiQ couplings and DRIVE-CLiQ cabinet bushings described in Chapter Accessories (Page 349).

11.3 Information on electromagnetic compatibility (EMC)

11.3.1 General information

Requirements to implement EMC are listed in EN 61800-3 and in the "EMC installation guideline" Configuration Manual (Article No. 6FC5297-0AD30-0.P.). Conformance with the EMC Directive of the EC can be ensured by following the measures described in the "EMC installation guideline" Configuration Manual.

When mounting components in cabinets, in order to fulfill the EMC Directive, the following conditions must be additionally observed:

- Connected to TN or TT line supply systems with grounded neutral point
- SINAMICS line filter
- Observance of information about cable shielding and equipotential bonding
- Use of the recommended power and signal cables from Siemens.
- Only use cables from Siemens for the DRIVE-CLiQ connections (see Chapter DRIVE-CLiQ signal cables (Page 377))

Connection authorization

Note

Connection authorization

- Converter with a type rating ≤ 1 kW:
It cannot be guaranteed that the limit values are complied with corresponding to IEC 61000-3-2. The installation person/company or company operating the professionally used device must obtain authorization from the local power utility to connect the device regarding the harmonic currents (Page 136).
 - Converter with a type rating > 1 kW and a rated input current ≤ 16 A:
These devices are not subject to any limit values, and as a consequence can be connected to the public low-voltage grid without any prior consultation.
 - Converters with a rated input current > 16 A and ≤ 75 A:
With a three-phase connection, the devices are compliant with IEC 61000-3-12, under the assumption that the short-circuit power (fault level) SSC at the connection point of the customers system with the public grid is greater than or equal to the value in the formula below.
$$SSC \geq 120 \cdot \sqrt{3} \cdot U_{in} \cdot I_N$$

For PM240-2 FSB and FSB, a line reactor with $U_k = 4$ % must also be connected upstream.
The installation company or company operating the equipment is responsible for ensuring that this equipment is only connected at a connection point with an appropriate short-circuit power (fault level).
In the following cases, the installation company or company operating the device must obtain authorization from the power utility company to connect the device regarding the harmonic currents.
 - Three-phase connection to a line supply with lower short-circuit power
 - Three-phase connection of FSB or FSC without line reactor - or with line reactor $U_k < 4$ %
 - Single-phase connection of devices with a rated input current > 16 A
 - Converter with a rated input current > 75 A:
There are no standard-related requirements for installing devices such as these. However, it is recommended to inform the power utility company when connecting such a device.
-

11.3.2 Environments and categories

EMC environments and EMC categories are defined as follows in the EMC product standard EN 61800-3:

Environments

IEC/EN 61800-3 makes a distinction between the first and second environments - and defines different requirements for these environments.

First environment

Residential buildings or locations at which the drive system is directly connected to a public low-voltage supply without intermediate transformer.

Second environment

All locations outside residential areas. These are basically industrial areas that have their own medium-voltage supply via their own transformers.

Categories

IEC/EN 61800-3 makes a distinction between four drive system categories:

Category C1

Drive systems for rated voltages < 1000 V for unrestricted use in the first environment.

Category C2

Stationary drive systems for rated voltages < 1000 V for operation in the second environment.

Note

Disturbance of radio communication services due to radio-frequency interferences in residential environments

In a residential environment, this product can cause radio-frequency interferences, which may make interference suppression measures necessary.

- Have qualified personnel carry out the installation and commissioning with suitable interference suppression measures.
-

Category C3

Drive systems for rated voltages < 1000 V - only for operation in the second environment.

Note

Disturbance of radio communication services due to radio-frequency interferences in residential environments

In a residential environment, this product can cause radio-frequency interferences.

- Do not use this device in the first environment (residential area).
-

Category C4

Drive systems for IT line supplies for operation in complex systems in the second environment. An EMC plan must be drawn up.

SINAMICS S120 units are designed for use in the second environment.

11.3.3 Interference emissions and interference immunity

Emitted interference

Radio interference suppression filters are required in order to limit interference emission. These filters can either be integrated in the device, or externally mounted.

Interference immunity

With reference to interference immunity, SINAMICS S120 units can also be used in the first environment.

Note

Integrating SINAMICS S120 in other plants/machines

When PDS (variable-speed drive systems) are integrated in other plants/machines, additional measures may be required in order to comply with their product standards.

With respect to the compliance with limits for harmonic currents, the EMC product standard EN61800-3 for PDS refers to compliance with standards EN 61000-3-2 and EN 61000-3-12.

Converters are classified as equipment used on a professional basis, deployed in certain areas of business and industry - and are not operated in the general public domain.

The following general conditions must be observed when used in the first environment:

- The drive system must be installed in compliance with EMC regulations by appropriately trained professionals.
- The converters must be equipped with a Category C2 line filter.
- The device-specific information and instructions for maintaining harmonic current limits must be complied with. Typical values, see Chapter "Harmonic currents (Page 136)".

11.4 Cable shielding and routing

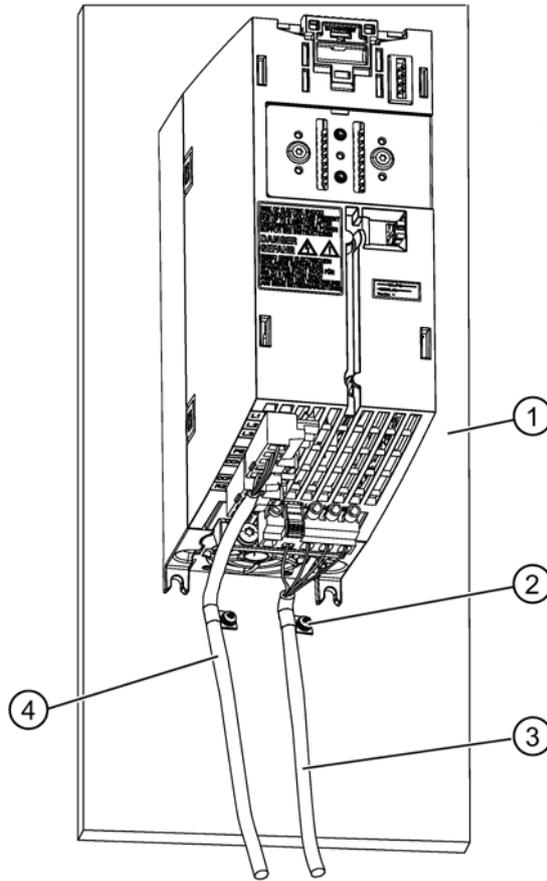
In particular for meeting the requirements of EMC, certain cables must be routed with sufficient spacing and certain components must be mounted with a suitable clearance. To full EMC requirements, the following cables must be used with shields:

- Power supply cables from line filter via line reactor to Power Module
- All motor cables (if necessary, including cables for motor holding brake)
- Cables for "fast inputs" of the Control Unit
- Cables for analog direct voltage/current signals
- Signal cables for encoders
- Cables for temperature sensors

Alternative measures (e.g. routing behind mounting plates, suitable clearances) can also be used provided they have similar results. This excludes measures that relate to the design,

installation, and routing of motor power cables and signal cables. If unshielded cables are used between the line supply connection point and the line filter, make sure that no interfering cable is routed in parallel.

The cable shields must be connected as close to the conductor terminal connections as possible to ensure a low-impedance connection with cabinet ground.



- ① Rear metal panel
- ② Clip to secure the shield of the motor and line cable to the rear metal panel
- ③ Motor cable (shielded)
- ④ Line supply input (shielded)

Figure 11-1 Shielding of a PM240-2 Power Module, frame size FSA

Alternatively, the cable shields can be connected to them metal mounting plate using pipe clamps and serrated rails. The cable length between the shield connection point and the wire terminals must be kept as short as possible.

Shield connection plates and shield connection kits with pre-prepared clip contacts are available for connecting the shields of power cables used for Power Modules.

All cables inside the cabinet must be connected as closely as possible to parts connected with cabinet ground, such as a mounting plate or cabinet wall. Ducts made of sheet steel or routing cables between between steel sheets (e.g. between the mounting plate and back wall) should provide adequate shielding.

11.5 24 V DC Supply Voltage

Avoid, where possible, routing non-shielded cables, connected to the drive line-up, in the immediate vicinity of noise sources, e.g. transformers. Signal cables (shielded and unshielded) connected to the drive line-up must be laid at a great distance from strong external magnetic sources (e.g. transformers, line reactors). In both cases, a distance of ≥ 300 mm is usually sufficient.

Routing 24 V cables

When routing 24 V cables, the following must also be observed:

- No more than 1 conductor pair may be bundled together.
- 24 V conductors must be routed separately from other cables and conductors that could conduct the operating current.
- 24 V cables must never be routed parallel to power cables.
- 24 V cables as well as power cables should be routed to the components so that they never cover ventilation slots

Conditions of use for 24 V cables

- Ambient temperature 55 °C
- Limit conductor temperature, $\leq 70^\circ$ C for operation with the rated load current
- Cable length up to 30 m for 24-V power supply cables or for signal cables without additional circuit elements

11.5 24 V DC Supply Voltage

11.5.1 General

The 24 VDC voltage is required for the power supply:

1. The load voltage of the Control Unit digital outputs
The Control Units are supplied with power via the PM-IF. 24 V must also be connected in the following cases:
 - Commissioning / diagnostics when the Power Module power supply is switched-out.
 - Using the digital outputs CU310-2
2. The electronics of Sensor Modules
3. The Safe Brake Relay (motor holding brakes)

Other loads can be connected to these power supply units if they are separately protected from overcurrent.

Note

The electronic power supply (PELV/SELV) has to be supplied by the user as described in Chapter System data for PM240-2 Blocksize Power Modules (Page 39).

When connecting a "DC power supply" according to EN 60204-1 malfunctions can occur as a result of the voltage interruptions that are permitted there.

NOTICE**Damage to further loads due to overvoltage**

Overvoltage from switched inducted loads (contactors, relays) can damage connected loads.

- Install suitable overvoltage protection.
-

Note**Malfunction because 24 V supply voltage is too low**

If the 24 V supply voltage falls short of the specified minimum value on a device in the assembly, a malfunction can occur.

- Select an input voltage that is high enough for there to be sufficient voltage on the last device. Do not exceed the maximum value for the supply voltage. If required, supply the voltage to the assembly at various locations.
-

Note

A regulated DC power supply is required to operate motors with a built-in holding brake. The power is supplied via the 24 V connection (Safe Brake Relay). The voltage tolerances of the motor holding brakes ($24\text{ V} \pm 10\%$) and the voltage drops of the connecting cables must be taken into account.

The DC power supply should be set to 26 V. This ensures that the supply voltage for the brake remains within the permissible range when the following conditions are fulfilled:

- Use of Siemens three-phase motors
 - Use of Siemens MOTION-CONNECT power cables
 - Motor cable lengths: max. 100 m
-

11.5.2 Overcurrent protection

The cables on the primary and secondary sides of the 24 V power supply unit must be protected against overcurrent.

Primary side protection must be implemented according to the manufacturer's instructions.

Secondary side protection depends on the prevailing situation. Please note the following:

- Loading due to loads, including simultaneity factor depending on machine operation
- Current carrying capacity of the conductors used and cables in normal and short-circuit conditions
- Ambient temperature
- Cable bundling (routing cables in a common duct)
- Cable routing method according to EN 60204-1

The overcurrent protection devices can be determined according to EN 60204-1.

Circuit-breakers from Siemens Catalogs LV 1 and LV 1T are recommended as overcurrent protection devices on the primary side.

Miniature circuit-breakers or SITOP select (Article No. 6EP1961-2BA00) are recommended as overcurrent protection devices on the secondary side. The miniature circuit-breakers can also be selected from Siemens LV 1 and LV 1T Catalogs.

Miniature circuit-breakers are recommended as overcurrent protection devices for the cables and busbars. The ground potential M must be connected to the protective conductor system (PELV/SELV).

When selecting the miniature circuit-breaker, local installation regulations must be carefully complied with.

Table 11- 1 MCBs by conductor cross section and temperature

Conductor cross section	Max. value up to 40° C	Max. value up to 55° C
1.5 mm ² (AWG 16)	10 A	6 A
2.5 mm ² (AWG 14)	16 A	10 A
4 mm ² (AWG 12)	25 A	16 A
6 mm ² (AWG 10)	32 A	20 A

The tripping characteristic of the circuit-breaker is selected so that loads remain protected against the maximum current that occurs in the event of a short circuit of the power supply unit.

11.5.3 Overvoltage protection

Surge protection devices are required for cable lengths greater than 30 m.

The following Weidmüller overvoltage protectors are recommended for protecting the components' 24 V power supply and the 24 V signal cables from overvoltage:

Table 11- 2 Recommendations for overvoltage protection

24 V power supply	24 V signal cables
Weidmüller Item no.: PU III R 24V Article No.: 8860360000	Weidmüller Item no.: MCZ OVP TAZ Article No.: 844915 0000

The overvoltage protectors must always be placed next to the area to be protected, e.g. at the entry point to the cabinet.

11.5.4 Typical 24 V current consumption of the components

A separate 24 V power supply must be used for the SINAMICS S120 drive line-up.

The following table can be used to calculate the 24 VDC power supply. The values for typical current consumption are used as a basis for configuration.

Table 11- 3 Overview of 24 VDC current consumption

Component	Typical current consumption [A _{DC}]
Control Units and Control Unit Adapters	
CU310-2 DP without load For each digital output	0.8 0.1
CU310-2 PN without load For each digital output	0.8 0.1
CUA31 without DRIVE-CLiQ	0.15
CUA32 without DRIVE-CLiQ or encoder Encoder (max.)	0.15 0.4
DRIVE-CLiQ and brake	
DRIVE-CLiQ (e.g. motors with DRIVE-CLiQ interface)	typ. 0.25/max. 0.45
Brake (e.g. motor holding brake)	Typical 0.4 to 1.1; max. 2
Sensor Module Cabinet	
SMC10 without/with encoder system	0.20/0.35
SMC20 without/with encoder system	0.20/0.35
SMC30 without/with encoder system	0.20/0.55
Sensor Module External	
SME20 without/with encoder system	0.15/0.25
SME25 without/with encoder system	0.15/0.25
SME120 without/with encoder system	0.20/0.30
SME125 without/with encoder system	0.20/0.30

11.5.5 Selecting power supply units

You are advised to use the devices in the following table. These devices meet the applicable requirements of EN 60204-1.

Table 11-4 Recommended SITOP Power

Rated output current [A]	Phases	Rated input voltage [V] Operating voltage range [V]	Short-circuit current [A]	Article No.
5	1 / 2	AC 120 ... 230/230 ... 500 85 ... 264/176 ... 550	Approx. 5.5 (powering up) Typ. 15 for 25 ms (in operation)	6EP1333-3BA00-8AC0
10	1 / 2	AC 120 ... 230/230 ... 500 85 ... 264/176 ... 550	Approx. 12 (powering up) Typ. 30 for 25 ms (in operation)	6EP1334-3BA00-8AB0
20	1 / 2	AC 120 / 230 85 ... 132/176 ... 264	Approx. 23 (powering up) Typ. 60 for 25 ms (in operation)	6EP1336-3BA00-8AA0
	3	3 AC 230/400 ... 288/500 320 ... 550		6EP1436-3BA00-8AA0
40	1 / 2	AC 120/230 85 ... 132/176 ... 264	Approx. 46 (powering up) Typ. 120 for 25 ms (in operation)	6EP1337-3BA00-8AA0
	3	3 AC 230/400 ... 288/500 320 ... 550		6EP1437-3BA00-8AA0



⚠ WARNING

Hazardous voltage when connecting an unsuitable power supply

If a power supply is connected that is not suitable, parts and components of the device could be live (under voltage). Touching live components can result in death or severe injury.

- Connect the ground potential to the PE conductor connection.
- Mount the power supply close to the drive lineup.

Ideally, they should be mounted on a common mounting plate. If different mounting plates are used, they must be electrically connected in compliance with the Configuration Manual, "EMC installation guideline".

11.6 Connection Methods

11.6.1 DRIVE-CLiQ signal cables

11.6.1.1 Overview

To connect DRIVE-CLiQ components, various pre-assembled and non-assembled DRIVE-CLiQ signal cables are available. The following pre-assembled DRIVE-CLiQ signal cables will be discussed in more detail in the next sections:

- Signal cables without 24 V cores with RJ45 connectors
- MOTION-CONNECT signal cables with RJ45 connectors
- MOTION-CONNECT signal cables with RJ45 connector and M12 socket

The maximum length of the DRIVE-CLiQ MOTION-CONNECT signal cables is:

- 100 m for MOTION-CONNECT 500 cables
- 75 m for MOTION-CONNECT 800PLUS cables

Table 11- 5 Overview of pre-assembled DRIVE-CLiQ signal cables

Type of DRIVE-CLiQ signal cable	24 V cores	Degree of protection		Connector type
		IP20	IP67	
6SL3060-4A.. 6FX2002-1DC..	-	x	x	RJ45
6FX5002-2DC00.. bis .. -2DC20.. 6FX8002-2DC00.. bis .. -2DC20..	x	x	x	RJ45
6FX5002-2DC30.. 6FX8002-2DC30..	x	x (RJ45)	x (M12)	RJ45 / M12

11.6.1.2 DRIVE-CLiQ signal cables without 24 V DC cores

Pre-assembled DRIVE-CLiQ signal cables without 24 V DC cores are used to connect components with DRIVE-CLiQ connection, which have a separate or external 24 V DC power supply. They are mainly intended for use in control cabinets. The signal cables are available with RJ45 connectors in degrees of protection IP20 and IP67.

Table 11- 6 Actual cable lengths of DRIVE-CLiQ bridges

DRIVE-CLiQ bridge	Cable length L ¹⁾
50 mm	110 mm
100 mm	160 mm
150 mm	210 mm
200 mm	260 mm
250 mm	310 mm

DRIVE-CLiQ bridge	Cable length L ¹⁾
300 mm	360 mm
350 mm	410 mm

¹⁾ Cable length without connector

Cable lengths from 600 mm and higher are used to connect to other applications (e.g. establish a 2nd line in the drive line-up, establish wiring in a star configuration etc.)

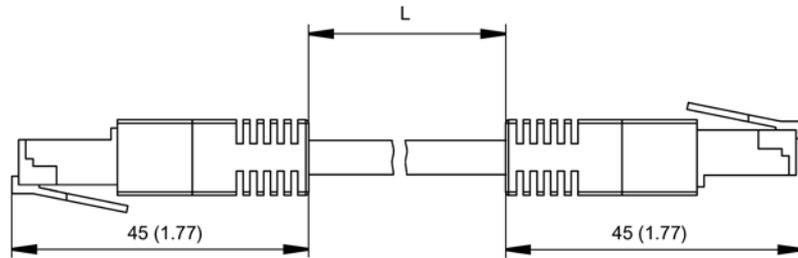


Figure 11-2 DRIVE-CLiQ signal cables without 24 V DC cores (IP20)

11.6.1.3 DRIVE-CLiQ signal cables MOTION-CONNECT with DRIVE-CLiQ connectors

The MOTION-CONNECT DRIVE-CLiQ signal cables with DRIVE-CLiQ connectors have 24 V DC cores. They are used for components with DRIVE-CLiQ connection if higher requirements must be complied with, such as mechanical stress and resistance to oil. For example, the signal cables are used for connections outside the control cabinet

The maximum length of the DRIVE-CLiQ MOTION-CONNECT signal cables with DRIVE-CLiQ connectors is:

- 100 m for MOTION-CONNECT 500 cables
- 75 m for MOTION-CONNECT 800PLUS cables

The signal cables are available in degrees of protection IP20 and IP67.

Note

DRIVE-CLiQ cabinet bushing for DRIVE-CLiQ connectors

For information about the cabinet bushing, see DRIVE-CLiQ cabinet bushings (Page 349).

11.6.1.4 MOTION-CONNECT DRIVE-CLiQ signal cables with DRIVE-CLiQ connector and M12 socket

The MOTION-CONNECT DRIVE-CLiQ signal cables with DRIVE-CLiQ connector and M12 socket have 24 V DC cores. They establish the connection between components with a DRIVE-CLiQ connection and a direct measuring system equipped with DRIVE-CLiQ ASIC with 8-pin M12 connector. Measuring systems from third-party manufacturers can be directly connected to the SINAMICS S120.

Basic cable

The pre-assembled basic cable has eight cores, of which four are used for data transmission and two for the 24 V supply. It is used to convert from a DRIVE-CLiQ connector (IP20) to an M12 socket (IP67).



Figure 11-3 DRIVE-CLiQ basic cable with DRIVE-CLiQ connector and M12 socket

Extension

The pre-assembled extension of a basic cable has an M12 plug (IP67) and an M12 socket (IP67).



Figure 11-4 DRIVE-CLiQ extension with M12 plug and M12 socket

Note

Maximum number of extensions

A maximum of two extensions can be used. More than two extensions can result in data transfer errors.

Note

Maximum permissible total cable length

The maximum permissible total cable length between the measuring system and the DRIVE-CLiQ socket of the SINAMICS S120 device is 30 m. For a longer total cable length, data transfer errors may occur. This is the reason that no additional extension can be connected to a 30 m long basic cable.

Note

DRIVE-CLiQ cabinet bushing with M12 plug

For information about the cabinet bushing, see DRIVE-CLiQ cabinet bushings (Page 349).

11.6.1.5 Comparison of DRIVE-CLiQ signal cables

DRIVE-CLiQ signal cables are designed for various applications. The following table provides an overview of the most important properties.

Table 11- 7 Properties of DRIVE-CLiQ signal cables

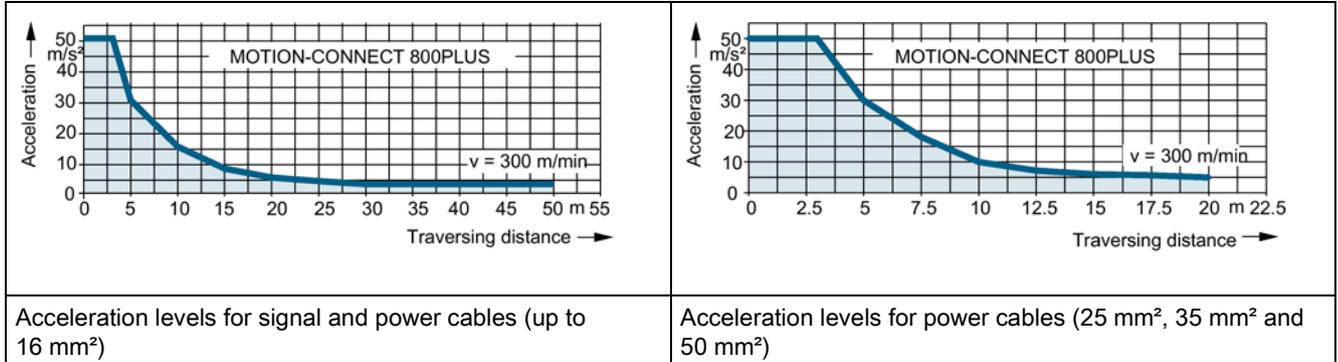
DRIVE-CLiQ signal cable	DRIVE-CLiQ	DRIVE-CLiQ MOTION-CONNECT 500	DRIVE-CLiQ MOTION-CONNECT 800PLUS
Approvals			
cURus or UR/CSA ¹⁾ In conformance with RoHS	Yes Yes	Yes Yes	Yes Yes
Rated voltage V₀/V in accordance with EN 50395	30 V	30 V	30 V
Test voltage, rms	500 V	500 V	500 V
Operating temperature at the surface			
Permanently installed Moveable	-20 ... +80 °C -	-20 ... +80 °C 0 ... 60 °C	-20 ... +80 °C -20 ... +60 °C
Tensile load, max.			
Permanently installed Moveable	45 N/mm ² -	80 N/mm ² 30 N/mm ²	50 N/mm ² 20 N/mm ²
Smallest bending radius			
Permanently installed Moveable	25 mm -	35 mm 125 mm	35 mm 75 mm
Torsional stress	-	30 °/m absolute	30 °/m absolute
Bending operations	-	100000	10 million
Max. travel velocity	-	30 m/min	300 m/min
Max. acceleration	-	2 m/s ²	50 m/s ² (3 m distance moved through) ²⁾
insulation material	CFC/silicon-free	CFC/silicon-free	CFC/halogen/silicone-free IEC 60754-1 / DIN VDE 0472-815
Oil resistance	IEC 60811-100 and IEC 60811-404	IEC 60811-100 and IEC 60811-404 (mineral oil only)	IEC 60811-100 and IEC 60811- 404
Protective jacket	PVC Gray RAL 7032	PVC DESINA color green RAL 6018	PUR, HD22.10 S2 (VDE 0282, Part 10) DESINA color green, RAL 6018
Flame retardant	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

1) The UR/CSA file number is stamped on the cable sheath.

2) Acceleration characteristics, refer below

Characteristics for MOTION-CONNECT 800PLUS

The cables can be used in the area below the characteristic. The characteristics represent the tested operating points.



11.6.1.6 Combined use of MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS

In principle, MOTION-CONNECT 500 cables and MOTION-CONNECT 800PLUS cables be used together.

Basic cables and extensions for MOTION-CONNECT cables with RJ45 plug and M12 socket can be combined without any restrictions.

For the combined use of MOTION-CONNECT cables, the conditions below apply.

Use of DRIVE-CLiQ couplings

DRIVE-CLiQ couplings are used to combine MOTION-CONNECT 500 cables and MOTION-CONNECT 800PLUS cables. The maximum permissible cable length is calculated as follows:

Cables with RJ45 connectors: $\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5 m \leq 100 m$

Cables with M12 connectors: $\Sigma MC500 + 4/3 * \Sigma MC800PLUS \leq 100 m$

$\Sigma MC500$: Total length of all MC500 cable segments (fixed routing)

$\Sigma MC800PLUS$: Total length of all MC800PLUS cable segments (tow chain)

n_c : Number of DRIVE-CLiQ couplings (0 to max. of 3)

With this combination, DRIVE-CLiQ cables with a maximum length of over 75 m can also implemented for applications involving a tow chain.

Table 11- 8 Examples of maximum cable lengths when using a DRIVE-CLiQ coupling

$\Sigma MC500$ (fixed routing)	87 m	80 m	66 m	54 m	40 m	30 m	20 m	10 m	5 m
$\Sigma MC800PLUS$ (tow chain)	5 m	10 m	20 m	30 m	40 m	48 m	55 m	63 m	66 m
$\Sigma MC500+$ $\Sigma MC800PLUS$	92 m	90 m	86 m	84 m	80 m	78 m	75 m	73 m	71 m

Using a DRIVE CLiQ Hub Module

A DRIVE-CLiQ Hub Module (DMC20 or DME20) can be used to double the maximum permissible cable length for MOTION-CONNECT cables with RJ45 connectors. After the hub, the same length conditions apply as before the hub.

$$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5 \text{ m} \leq 100 \text{ m before the hub}$$

$$\Sigma MC500 + 4/3 * \Sigma MC800PLUS + n_c * 5 \text{ m} \leq 100 \text{ m after the hub}$$

It is possible to connect two DRIVE-CLiQ Hub Modules in series (cascade connection).

11.6.2 Power cables for motors

11.6.2.1 Configuring the cable length

The ohmic losses of the motor cable must be less than 5 % of the Power Module power rating.

Table 11- 9 Maximum cable lengths for Power Modules in the blocksize format

Frame size		Power Modules without filter		Power Modules with filter to maintain the limit values of EN 61800-3 Category C2/C3	
		shielded	unshielded	shielded	unshielded
FSA - FSC	200 V/400 V	50 m	100 m	50 m (C2) ¹⁾	-
FSD - FSE	200 V/400 V ²⁾	200 m	300 m	150 m (C2)	-
	690 V	200 m	300 m	100 m (C2)	-
FSF	200 V/400 V	300 m	450 m	150 m (C2)	-
	690 V	300 m	450 m	150 m (C3)	-
FSG	400 V	-	-	150 m (C2) 300 m (C3)	-
	690 V	-	-	300 m (C3)	-

1) A cable length up to 150 m is possible for C2 if you use an unfiltered Power Module with an external line filter for Category C2 and a motor reactor.

2) Also observe the restrictions for 6SL3210-1PE27-5UL0 and 6SL3210-1PE31-1UL0 Power Modules

- Motor cable length, 50 to 100 m: Set the pulse frequency to 2 kHz.
- Motor cable length > 100 m: Reduce the base load current for each 10 m by 1 %.

Table 11- 10 Maximum cable lengths for Power Modules in the chassis format

Frame size		Power Modules without filter		Power Modules with filter to maintain the limit values of EN 61800-3 Category C2/C3	
		shielded	unshielded	shielded	unshielded
FX - GX	400 V	300 m	450 m	100 m (C2)	-

11.6.2.2 Comparison of MOTION-CONNECT power cables

MOTION-CONNECT 500 power cables are mainly suitable for permanent routing. MOTION-CONNECT 800PLUS power cables fulfill all of the high mechanical requirements for use in tow chains. They are resistant to cutting oils.

Table 11- 11 Comparison of the MOTION-CONNECT 500 and MOTION-CONNECT 800PLUS power cables

Power cable	MOTION-CONNECT 500	MOTION-CONNECT 800PLUS
Approvals		
VDE ¹⁾ cURus or UR/CSA UR-CSA File No. ²⁾ in conformance with RoHS	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes	Yes UL758-CSA-C22.2-N.210.2-M90 Yes Yes
Rated voltage V_0/V in accordance with EN 50395		
Supply cores Signal cores	600 V/1000 V 24 V (EN) 1000 V (UL/CSA)	600 V/1000 V 24 V (EN) 1000 V (UL/CSA)
Test voltage, rms		
Supply cores Signal cores	4 kV 2 kV	4 kV 2 kV
Operating temperature at the surface		
Permanently installed Moveable	-20 ... 80 °C 0 ... 60 °C	-50 ... 80 °C -20 ... 60 °C
Tensile load, max.		
Permanently installed Moveable	50 N/mm ² 20 N/mm ²	50 N/mm ² 20 N/mm ²
Smallest bending radius		
Permanently installed Moveable	5 x D _{max} approx. 18 x D _{max} (Details see SIEMENS Industry Mall (https://mall.industry.siemens.com/mall/de/ww/catalog/products/7519999?activeTab=order&regionUrl=/))	4 x D _{max} approx. 8 x D _{max} (Details see SIEMENS Industry Mall (https://mall.industry.siemens.com/mall/de/ww/catalog/products/7519999?activeTab=order&regionUrl=/))
Torsional stress	30°/m absolute	30°/m absolute
Bending operations	100000	10 million From 10 mm ² : 3 million
Max. traversing speed	30 m/min	Up to 300 m/min
Max. acceleration	2 m/s ²	50 m/s ² (3 m) ³⁾
insulation material	Free of CFC/silicon	CFC/halogen/silicone-free IEC 60754-1
Oil resistance	EN 60811-2-1 (mineral oil only)	EN 60811-2-1
Protective jacket	PVC DESINA color, orange RAL 2003	PUR, HD22.10 S2 (VDE 0282, Part 10) DESINA color, orange, RAL 2003
Flame retardant	EN 60332-1-1 to 1-3	EN 60332-1-1 to 1-3

1) The registration number is printed on the cable jacket.

2) The file number is printed on the cable jacket.

3) Characteristic for acceleration, see Chapter "Comparison of DRIVE-CLiQ cables".

11.6.3 Spring-loaded terminals

Table 11- 12 Spring-loaded terminals

Spring-loaded terminal type			
1	Connectable cable cross-sections	Rigid	0.2 ... 1.5 mm ²
		Flexible	0.2 ... 1.5 mm ²
		Flexible with end sleeve without plastic sleeve	0.25 ... 1.5 mm ²
		Flexible with end sleeve with plastic sleeve	0.25 ... 0.75 mm ²
AWG/kcmil		24 ... 16	
Insulation stripping length		10 mm	
Tool		Screwdriver 0.4 x 2.0 mm	

11.6.4 Screw terminals

Connectable conductor cross-sections of screw terminals

The type of screw terminal can be taken from the interface description of the particular component.

Table 11- 13 Screw terminals

Screw terminal type				
1	Connectable cable cross-sections	Flexible	0.14 ... 1.5 mm ²	
		With end sleeve, without plastic sleeve	0.25 ... 1.5 mm ² (AWG 24 ... AWG 16)	
		With end sleeve, with plastic sleeve	0.25 ... 0.5 mm ² (AWG 24 ... AWG 20)	
	Insulation stripping length		7 mm	
	Tool		Screwdriver 0.4 x 2.0 mm	
Tightening torque		0.22 ... 0.25 Nm (2 ... 4 lbf in)		
2	Connectable cable cross-sections	Rigid, flexible	0.2 ... 2.5 mm ²	
		With end sleeve, without plastic sleeve	0.2 ... 2.5 mm ²	
		With end sleeve, with plastic sleeve	0.2 ... 1.5 mm ²	
		AWG / kcmil	22 ... 12	
	Insulation stripping length		6 ... 7 mm	
Tool		Screwdriver 0.5 x 3 mm		
Tightening torque		0.4 ... 0.5 Nm (3.5 ... 4.4 lbf in)		

11.7 Protective connection and equipotential bonding

Protective connections

The SINAMICS S drive system is designed for use in cabinets with a protective conductor connection.

The protective conductor connection of the SINAMICS components must be connected to the protective conductor connection of the control cabinet as follows:

Table 11- 14 Conductor cross-section for copper protective connections

Line supply cable in mm ²	Copper protective connection in mm ²
To 16 mm ² (AWG 6)	The same as the line supply cable
From 16 ... 35 mm ² (AWG 6 ... 2)	16 mm ²
From 35 mm ² (AWG 2)	0.5 x line supply cable

For materials other than copper, the cross-section should be increased so that as a minimum, the same conductivity is attained.

All system components and machine parts must be incorporated in the protection concept.

The protective ground connection of the motors used must be established through the motor cable.



! WARNING

Electric shock caused by high leakage currents when the protective conductor in the line feeder cable is interrupted

The drive components conduct a high leakage current via the protective conductor. Touching conductive parts when the protective conductor is interrupted can result in death or serious injury.

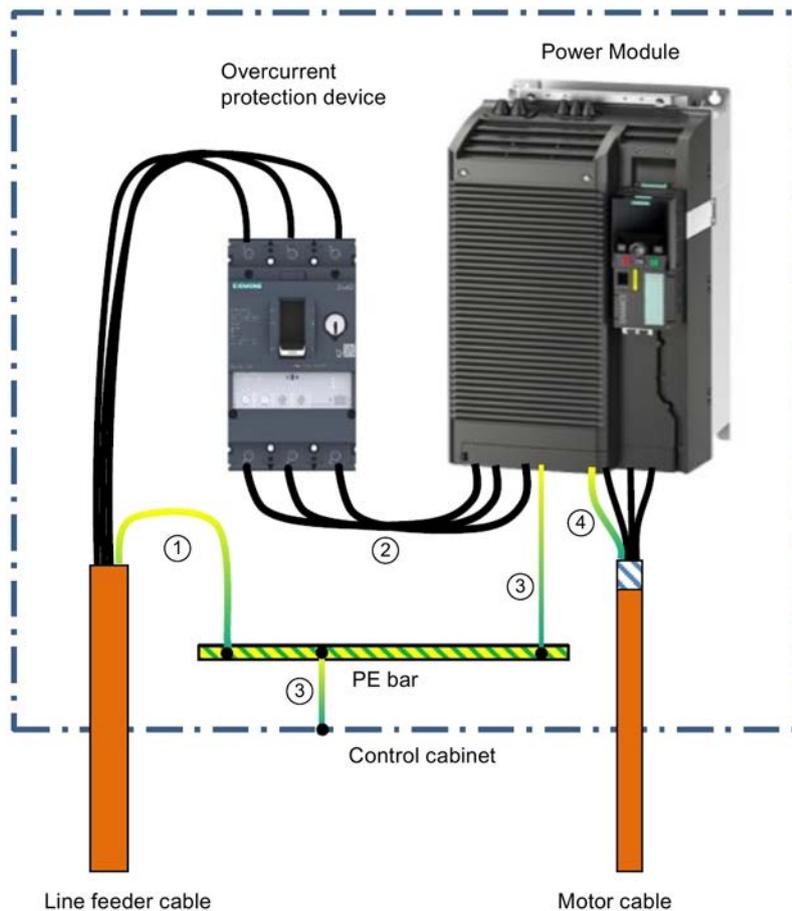
- Carefully comply with the applicable regulations for dimensioning the protective conductor (see below).

Protection connection concept for SINAMICS blocksize

Power Modules blocksize should always be connected with a protective conductor to the central PE busbar or the conductive mounting plate in the control cabinet (see the following diagram).

Note

Ensure that for increased leakage currents, the local regulations for protective conductors at the installation site are complied with.



- ① Within a machine/system, ensure that the protective conductor for the line feeder cable fulfills at least one of the following conditions:
- For fixed connection:
- The protective conductor is routed so that along its complete length it is protected against mechanical damage.¹⁾
 - As a conductor of a multi-conductor cable, the protective conductor has a cross-section $\geq 2.5 \text{ mm}^2 \text{ Cu}$.
 - For an individual conductor, the protective conductor has a cross-section $\geq 10 \text{ mm}^2 \text{ Cu}$.
 - The protective conductor consists of two conductors with the same cross-section.
- When establishing the connection using an industrial plug connector according to EN 60309:
- As a conductor of a multi-conductor cable, the protective conductor has a cross-section $\geq 2.5 \text{ mm}^2 \text{ Cu}$.
- ¹⁾ Cables routed within control cabinets or closed machine housings are considered to be adequately protected against mechanical damage.
- ② The cable cross-sections must be dimensioned in compliance with local installation rules for the rated current of the Power Module.
- ① Minimum cross section $6 \text{ mm}^2 \text{ Cu}$. Only if the cross-section of the conductors is ② less than 6 mm^2 can this connection be appropriately reduced.
- ① Same cross-section as the line conductor.

Figure 11-5 Protection connection concept for Power Modules blocksize format

Functional equipotential bonding

For EMC reasons, the shield of the motor cable should be connected through a large surface area both at the Power Module as well as at the motor.

The drive line-up must be arranged on a common bright mounting plate in order to comply with the EMC limit values. The mounting plate must be connected to the protective conductor connection of the control cabinet through a low impedance. It simultaneously serves as a functional equipotential bonding surface. This means that no additional functional equipotential bonding is required within the drive line-up.

If a single, bare metal mounting plate is not available, then equally good functional equipotential bonding must be established using cable cross-sections as listed in the table above or, as a minimum, with the same conductivity.

When mounting components on standard mounting rails, the data listed in the table apply. If only smaller connection cross-sections are permissible at the components, then the largest possible cross-section should be used, e.g. 6 mm² for SMC. These requirements also apply to distributed components located outside the control cabinet.

Copper cables with appropriate cross-sections (> 2.5 mm²) must be used for the functional equipotential bonding of PROFIBUS nodes.

NOTICE

Component destruction as a result of high leakage currents

The Control Unit or other PROFIBUS and/or PROFINET nodes can be destroyed, if significant leakage currents flow via the PROFIBUS or PROFINET cable.

- Use a functional equipotential bonding conductor with a cross section of at least 10 mm² between components of an installation that are located at a distance from each other.

No functional equipotential bonding conductors are required for PROFIBUS inside a control cabinet. For PROFIBUS connections between different buildings or parts of buildings, a functional equipotential bonding must be routed in parallel to the PROFIBUS cable. The following cross-sections must be observed in accordance with IEC 60364-5-54:

- Copper 6 mm²
- Aluminum 16 mm²
- Steel 50 mm²

Additional information about equipotential bonding for PROFIBUS can be found at:
http://www.profibus.com/fileadmin/media/wbt/WBT_Assembly_V10_Dec06/index.html

Note

Non-observance of the above guidelines on functional equipotential bonding can lead to faults on the fieldbus interfaces or to malfunction of the devices.

Note

PROFINET

For installation guidelines and information of protective grounding and equipotential bonding for all PROFINET types and topologies, refer to DOWNLOADS at:
<http://www.profibus.com>

11.8 Information on control cabinet cooling

11.8.1 General

Electrical cabinets can be cooled, using among other things with the following:

- filtered fans
- heat exchangers or
- cooling units.

The decision in favor of one of these methods depends on the prevailing ambient conditions and the cooling power required.

The air routing inside the control cabinet and the ventilation clearances specified here, must be carefully observed. Other components or cables must not be installed/routed in these areas.

You must comply with the following specifications when installing SINAMICS components:

- Cooling clearance
- Cable routing
- Air guidance, air-conditioner

Table 11- 15 Ventilation clearances around the components

Component	Clearance above and below in mm and (inches)	Clearance in front of the component in mm and (inches)
CU310-2 DP	50 (1.97)	
CU310-2 PN	50 (1.97)	
CUA31	50 (1.97)	
SMCxx	50 (1.97)	
Line filter	100 (3.93)	
Line reactor	100 (3.93)	
PM240-2 Blocksize, frame size FSA ... FSC	Above: 80 (3.15) Below: 100 (3.93)	
PM240-2 blocksize, frame size FSD ... FSF	Above: 300 (11.81) Below: 350 (13.78)	100 (3.94)

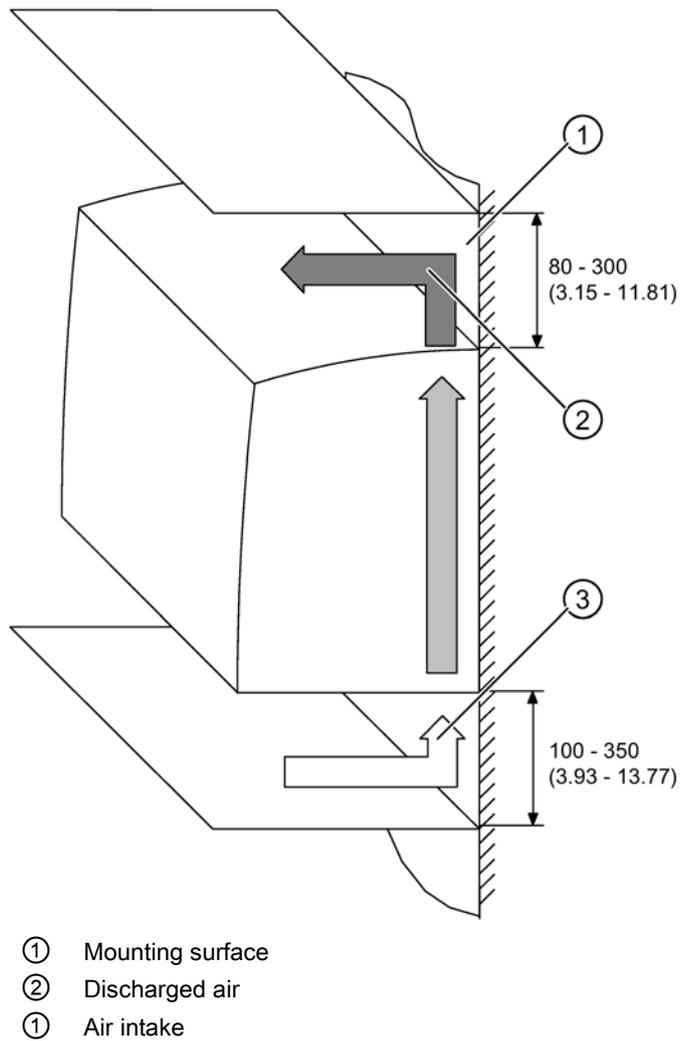


Figure 11-6 Ventilation clearances

11.8.2 Ventilation

The SINAMICS equipment is ventilated separately by means of integrated fans and is in some cases cooled by means of natural convection.

The cooling air must flow through the components vertically from bottom (cooler region) to top (region heated by operation).

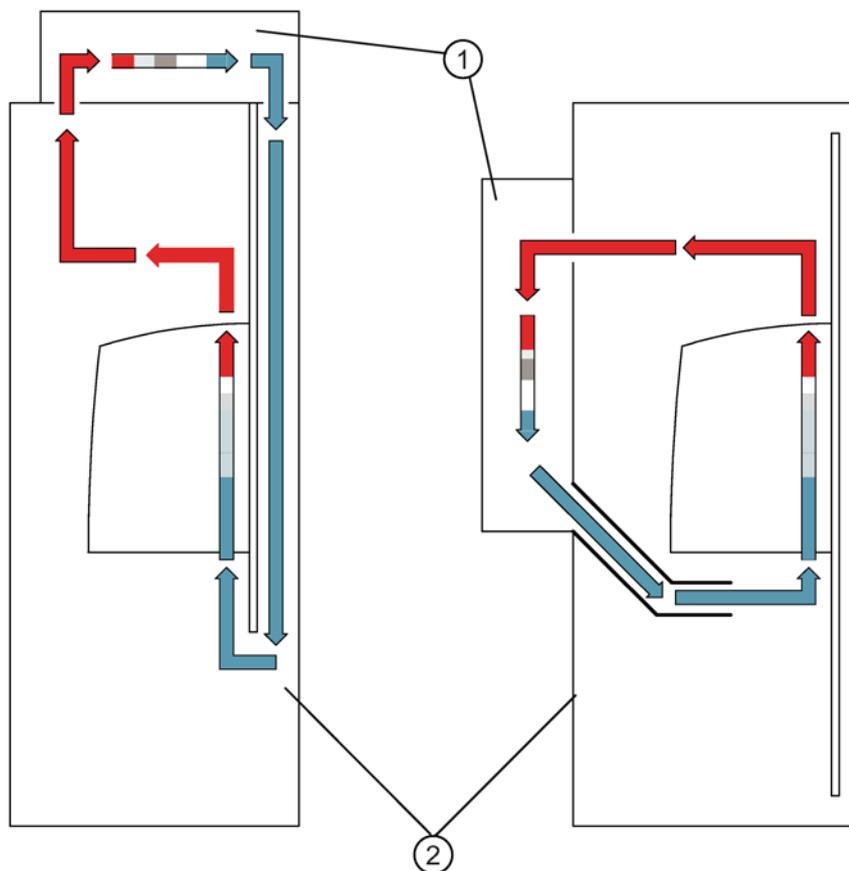
If filtered fans, heat exchangers, or air conditioners are used, you must ensure that the air is flowing in the right direction. You must also ensure that the warm air can escape at the top. The cooling clearance above and below must be observed.

NOTICE

Damage caused by overheating

Overheating can cause system damage.

- Install the components with the specified orientation.
- Maintain the minimum clearances to other components.
- Install a suitable ventilation in the control cabinet in order to dissipate the power loss.
- Install suitable air filters and keep the heat sink clean.
- Ensure that the components are provided with adequate cooling air through the cooling openings. In particular, the connected signal and power cables must not cover the ventilation openings.
- Ensure that the cooling air flow is not blocked by other devices or mixes with the exhaust air from other devices. If necessary, insert air deflectors.



- ① Cooling units.
- ② Control cabinet

Figure 11-7 Examples of cabinet ventilation

If air conditioners are used, the relative air humidity of the expelled air increases as the air in the air conditioner cools and may exceed the dew point. To avoid condensation, climate control equipment should be arranged so that cold discharged air is not directly blown onto SINAMICS components. Using air guidance baffles, ensure that the air is adequately mixed with the air inside the cabinet. This reduces the relative air humidity to uncritical values.

NOTICE**Damage caused by condensation**

Condensation on the components can result in their failure.

- Select the air guidance and arrangement of the cooling equipment in such a way that no condensation can form on the components. The distance between the discharge opening of the air condition equipment and the electronic equipment must be at least 200 mm.
- If required, install cabinet enclosure heating.

11.8.3 Power loss of components in rated operation

11.8.3.1 General

The tables below show the power loss for components during rated operation. The characteristic values apply for the following conditions:

- Line voltage for Power Modules:
 - 1 AC 200 V to 240 V with permissible deviation
 - 3 AC 200 V to 240 V with permissible deviation
 - 3 AC 380 V to 480 V with permissible deviation
 - 3 AC 500 V to 690 V with permissible deviation
- Rated pulse frequency of the particular Power Module
- Operating components at their unit rating

11.8.3.2 Power loss of Control Units, Control Unit Adapters and Sensor Modules

Table 11- 16 Overview of power loss during rated operation for Control Units, Control Unit Adapters, Sensor Modules

Component	Unit	Power loss
Control Units		
CU310-2 DP	W	< 20
CU310-2 PN	W	20
Control Unit Adapter		
CUA31	W	2,4

11.8 Information on control cabinet cooling

Component	Unit	Power loss
CUA32	W	2,6
Sensor Modules		
SMC10	W	< 10
SMC20	W	< 10
SMC30	W	< 10

11.8.3.3 Power loss for line reactors and line filters

Table 11- 17 Overview of power loss during rated operation for line reactors and line filters

Rated output current I _{rated}	Frame size	Line voltage	Unit	Power loss 50/60 Hz
Line reactors for Power Modules blocksize				
4.0 A	FSA (1.1 kW)	3-phase 380 ... 480 VAC	W	23/25.3
11.3 A	FSA (4.0 kW)	3-phase 380 ... 480 VAC	W	36/39.6
22.3 A	FSB	3-phase 380 ... 480 VAC	W	53/58.3
47.0 A	FSC	3-phase 380 ... 480 VAC	W	88/96.8
Line reactors for Chassis Power Modules				
210 A	FX	3-phase 380 ... 480 VAC	W	274
260 A	FX	3-phase 380 ... 480 VAC	W	247
310 A	GX	3-phase 380 ... 480 VAC	W	267
380 A	GX	3-phase 380 ... 480 VAC	W	365
490 A	GX	3-phase 380 ... 480 VAC	W	365
Line filter for Power Modules blocksize				
15 A	FSA	3-phase 380 ... 480 VAC	W	13
23.5 A	FSB	3-phase 380 ... 480 VAC	W	22
49.4 A	FSC	3-phase 380 ... 480 VAC	W	39
Line filters for Chassis Power Modules				
210 A/260 A	FX	3-phase 380 ... 480 VAC	W	49
310 A/380 A	GX	3-phase 380 ... 480 VAC	W	49
490 A	GX	3-phase 380 ... 480 VAC	W	55

11.8.3.4 Power loss for Power Modules

Table 11- 18 Overview of power loss during rated operation for Power Modules

Rated output current I_{rated} /Unit rating based on I_{rated}	Frame size	Line voltage	Unit	Power loss
PM240-2 Blocksize				
3.0 A / 0.55 kW	FSA	1 AC / 3 AC 200 ... 240 V	kW	0.04
3.9 A / 0.75 kW	FSA	1 AC / 3 AC 200 ... 240 V	kW	0.04
5.5 A / 1.1 kW	FSB	1 AC / 3 AC 200 ... 240 V	kW	0.05
7.4 A / 1.5 kW	FSB	1 AC / 3 AC 200 ... 240 V	kW	0.07
10.4 A / 2.2 kW	FSB	1 AC / 3 AC 200 ... 240 V	kW	0.12
13.6 A / 3.0 kW	FSC	1 AC / 3 AC 200 ... 240 V	kW	0.14
17.5 A / 4.0 kW	FSC	1 AC / 3 AC 200 ... 240 V	kW	0.18
22.0 A / 5.5 kW	FSC	3 AC 200 ... 240 V	kW	0.20
28.0 A / 7.5 kW	FSC	3 AC 200 ... 240 V	kW	0.26
42 A / 11 kW	FSD	3 AC 200 ... 240 V	kW	0.45
54 A / 15 kW	FSD	3 AC 200 ... 240 V	kW	0.61
68 A / 18.5 kW	FSD	3 AC 200 ... 240 V	kW	0.82
80 A / 22 kW	FSE	3 AC 200 ... 240 V	kW	0.92
104 A / 30 kW	FSE	3 AC 200 ... 240 V	kW	1.28
130 A / 37 kW	FSF	3 AC 200 ... 240 V	kW	1.38
154 A / 45 kW	FSF	3 AC 200 ... 240 V	kW	1.72
178 A / 55 kW	FSF	3 AC 200 ... 240 V	kW	2.09
1.7 A / 0.55 kW	FSA	3 AC 380 ... 480 V	kW	0.04
2.2 A / 0.75 kW	FSA	3 AC 380 ... 480 V	kW	0.04
3.1 A / 1.1 kW	FSA	3 AC 380 ... 480 V	kW	0.04
4.1 A / 1.5 kW	FSA	3 AC 380 ... 480 V	kW	0.07
5.9 A / 2.2 kW	FSA	3 AC 380 ... 480 V	kW	0.10
7.7 A / 3.0 kW	FSA	3 AC 380 ... 480 V	kW	0.12
10.2 A / 4.0 kW	FSB	3 AC 380 ... 480 V	kW	0.11
13.2 A / 5.5 kW	FSB	3 AC 380 ... 480 V	kW	0.15
18.0 A / 7.5 kW	FSB	3 AC 380 ... 480 V	kW	0.20
26.0 A / 11 kW	FSC	3 AC 380 ... 480 V	kW	0.30
32.0 A / 15 kW	FSC	3 AC 380 ... 480 V	kW	0.37
38 A / 18.5 kW	FSD	3 AC 380 ... 480 V	kW	0.57
45 A / 22 kW	FSD	3 AC 380 ... 480 V	kW	0.70
60 A / 30 kW	FSD	3 AC 380 ... 480 V	kW	0.82
75 A / 37 kW	FSD	3 AC 380 ... 480 V	kW	1.09
90 A / 45 kW	FSE	3 AC 380 ... 480 V	kW	1.29
110 A / 55 kW	FSE	3 AC 380 ... 480 V	kW	1.65
145 A / 75 kW	FSF	3 AC 380 ... 480 V	kW	1.91
178 A / 90 kW	FSF	3 AC 380 ... 480 V	kW	2.46
205 A / 110 kW	FSF	3 AC 380 ... 480 V	kW	2.28

11.8 Information on control cabinet cooling

Rated output current I_{rated} /Unit rating based on I_{rated}	Frame size	Line voltage	Unit	Power loss
250 A / 132 kW	FSF	3 AC 380 ... 480 V	kW	2.98
302 A / 160 kW	FSG	3 AC 380 ... 480 V	kW	3.67
370 A / 200 kW	FSG	3 AC 380 ... 480 V	kW	4.62
477 A / 250 kW	FSG	3 AC 380 ... 480 V	kW	6.18
14 A / 11 kW	FSD	3 AC 500 ... 690 V	kW	0.35
19 A / 15 kW	FSD	3 AC 500 ... 690 V	kW	0.44
23 A / 18.5 kW	FSD	3 AC 500 ... 690 V	kW	0.52
27 A / 22 kW	FSD	3 AC 500 ... 690 V	kW	0.60
35 A / 30 kW	FSD	3 AC 500 ... 690 V	kW	0.77
42 A / 37 kW	FSD	3 AC 500 ... 690 V	kW	0.93
52 A / 45 kW	FSE	3 AC 500 ... 690 V	kW	1.07
62 A / 55 kW	FSE	3 AC 500 ... 690 V	kW	1.30
80 A / 75 kW	FSF	3 AC 500 ... 690 V	kW	1.37
100 A / 90 kW	FSF	3 AC 500 ... 690 V	kW	1.74
115 A / 110 kW	FSF	3 AC 500 ... 690 V	kW	1.95
142 A / 132 kW	FSF	3 AC 500 ... 690 V	kW	2.48
171 A / 160 kW	FSG	3 AC 500 ... 690 V	kW	3.0
208 A / 200 kW	FSG	3 AC 500 ... 690 V	kW	3.5
250 A / 250 kW	FSG	3 AC 500 ... 690 V	kW	4.1
Power Modules blocksize push through				
3.9 A / 0.75 kW	FSA	1 AC / 3 AC 200 ... 240 V	kW	0.04
10.4 A / 2.2 kW	FSB	1 AC / 3 AC 200 ... 240 V	kW	0.12
17.5 A / 4.0 kW	FSC	1 AC / 3 AC 200 ... 240 V	kW	0.18
22 A / 5.5 kW	FSC	3 AC 200 ... 240 V	kW	0.20
28 A / 7.5 kW	FSC	3 AC 200 ... 240 V	kW	0.26
68 A / 18.5 kW	FSD	3 AC 200 ... 240 V	kW	0.82
104 A / 30 kW	FSE	3 AC 200 ... 240 V	kW	1.28
178 A / 55 kW	FSF	3 AC 200 ... 240 V	kW	2.09
7.7 A / 3.0 kW	FSA	3 AC 380 ... 480 V	kW	0.12
18 A / 7.5 kW	FSB	3 AC 380 ... 480 V	kW	0.20
32 A / 15 kW	FSC	3 AC 380 ... 480 V	kW	0.37
75 A / 37 kW	FSD	3 AC 380 ... 480 V	kW	1.09
110 A / 55 kW	FSE	3 AC 380 ... 480 V	kW	1.65
250 A / 132 kW	FSF	3 AC 380 ... 480 V	kW	2.98
Power Modules Chassis				
210 A / 110 kW	FX	3-phase 380 ... 480 VAC	kW	2.46
260 A / 132 kW	FX	3-phase 380 ... 480 VAC	kW	3.27
310 A / 160 kW	GX	3-phase 380 ... 480 VAC	kW	4.00
380 A / 200 kW	GX	3-phase 380 ... 480 VAC	kW	4.54
490 A / 250 kW	GX	3-phase 380 ... 480 VAC	kW	5.78

12.1 Safety instructions for service and maintenance



WARNING

Electric shock due to the residual charge of the DC link capacitors

Because of the DC link capacitors, a hazardous voltage is present for up to five minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.

- Only carry out work on these components after this time has elapsed.
- Measure the voltage before starting work on the DCP and DCN DC-link terminals.



WARNING

Electric shock from the auxiliary supplies

If the auxiliary 230 VAC supplies are present, then a hazardous voltage is present at the components even when the main switch is in the open state. Contact with live parts can result in death or serious injury.

- Disconnect the existing auxiliary supply circuits from the supply.

WARNING

Improper transport or installation of devices and components

Serious injury or even death and substantial material damage can occur if the devices are not transported or installed professionally and correctly.

- Transport, mount, and remove the devices and components only if you are qualified to do so.
- Take into account that the devices and components are in some cases heavy and top-heavy and take the necessary precautionary measures.

12.2 Service and maintenance for components, Blocksize format

12.2.1 Replacing hardware components

The following components can be replaced with replacement components with the same Article No.:

- Power Modules
- DRIVE-CLiQ components
- Control Units

12.2.2 Replacing the fan CU310-2 DP and CU310-2 PN

The fan is located on the lower side of the CU310-2. It switches itself on according to the internal temperature in the unit.

If the internal temperature of the CU310-2 exceeds the permissible limit value, a category "CU" warning message signaling a Control Unit overtemperature will be output.

In this event, check for the following:

1. Is the cabinet temperature within the permitted range?
2. Is natural convection possible?
3. Is the fan blocked by dirt or foreign bodies?
4. Can the fan rotate freely?

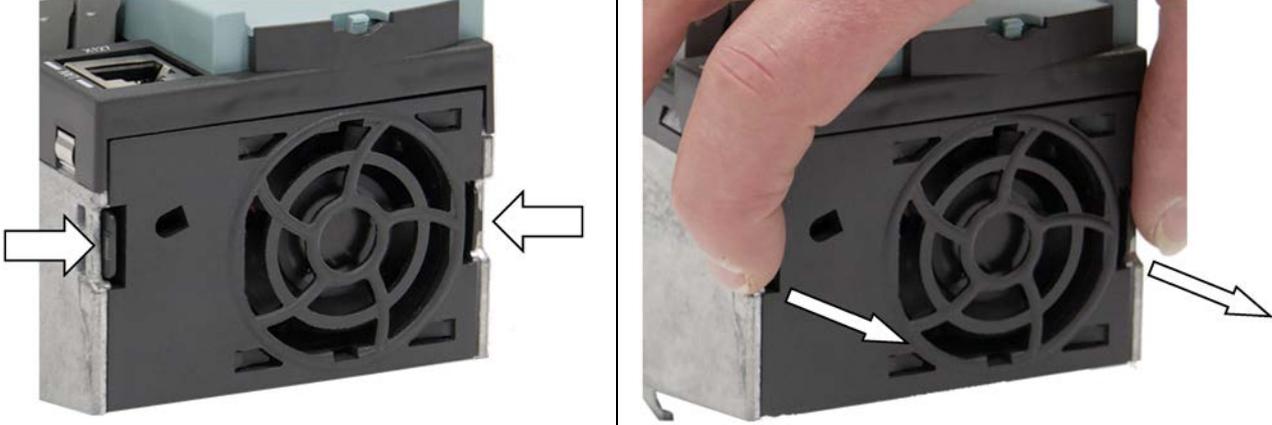
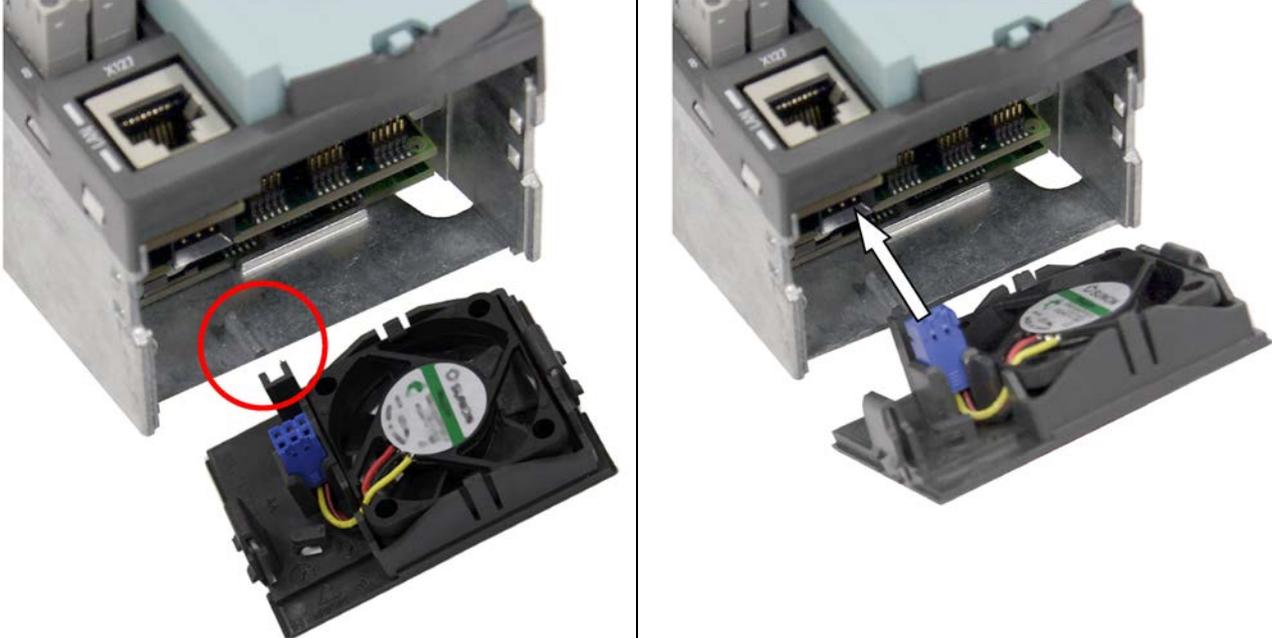
The warning message will be cleared as soon as the fault is rectified and the temperature falls below the permissible limit.

Note

If the fan does not rotate and all the sources of the fault (items 1 to 4) can be excluded, then the fan is faulty and must be replaced.

Replacing the fan

The fan is available as a spare part and has the article number: 6SL3064-1AC00-0AA0.

1.	Disconnect the drive line-up from the power supply.	
2.	Remove the CU310-2 from the drive line-up (see Chapter Mounting Control Units and Control Unit Adapters (Page 289).)	
		
	3.	Release the snap hooks on the left and right sides of fan by pressing them inwards.
4.	Remove the fan forwards out of the CU310-2's housing.	
		
	5.	Locate the centering frame of the replacement fan on the mounting cam of the CU310-2.
6.	Slide the replacement fan onto the mounting cam in the Control Unit. Ensure that the fan connector fits into the centering frame of the PC board. Engage the two snap hooks at the fan in the Control Unit housing.	
7.	Fit the CU310-2 to the drive line-up.	

12.2.3 Replacing the fan on the PM240-2

Fans are available as spare parts for all PM240-2 installation sizes.

Note

Only trained personnel may replace the fan, observing ESD guidelines.

For frame sizes FSA to FSC the fan module is mounted below. For frame sizes FSD to FSG it is located at the top.

The electrical connections are disconnected or established by withdrawing or inserting the fan module.

Frame size FSA ... FSC

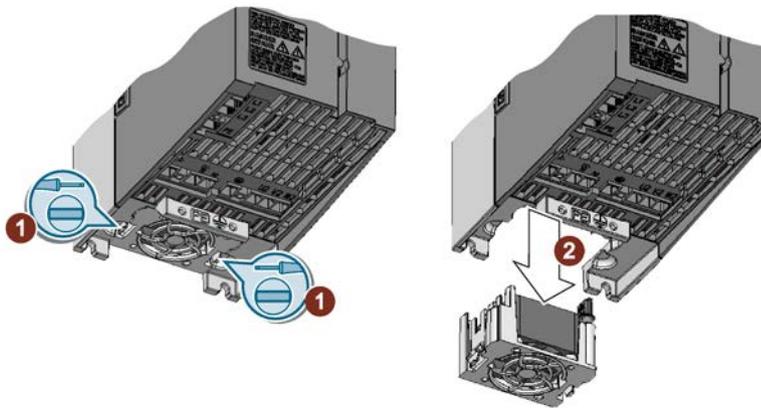


Figure 12-1 Fan replacement PM240-2, frame sizes FSA ... FSC

For frame sizes FSA and FSB the fan module has one fan, for frame size FSC, 2 fans.

Proceed as follows to replace a fan module:

1. Switch-off the Power Module, and wait 5 minutes until the DC link capacitors have been discharged.
2. Withdraw the connectors to the line supply, motor and braking resistor from the Power Module.
3. Remove the shield plate from the Power Module.
4. Remove the fan module from the Power Module as shown in the diagram.
5. Install the new fan module in the inverse sequence.

Frame sizes FSD ... FSF

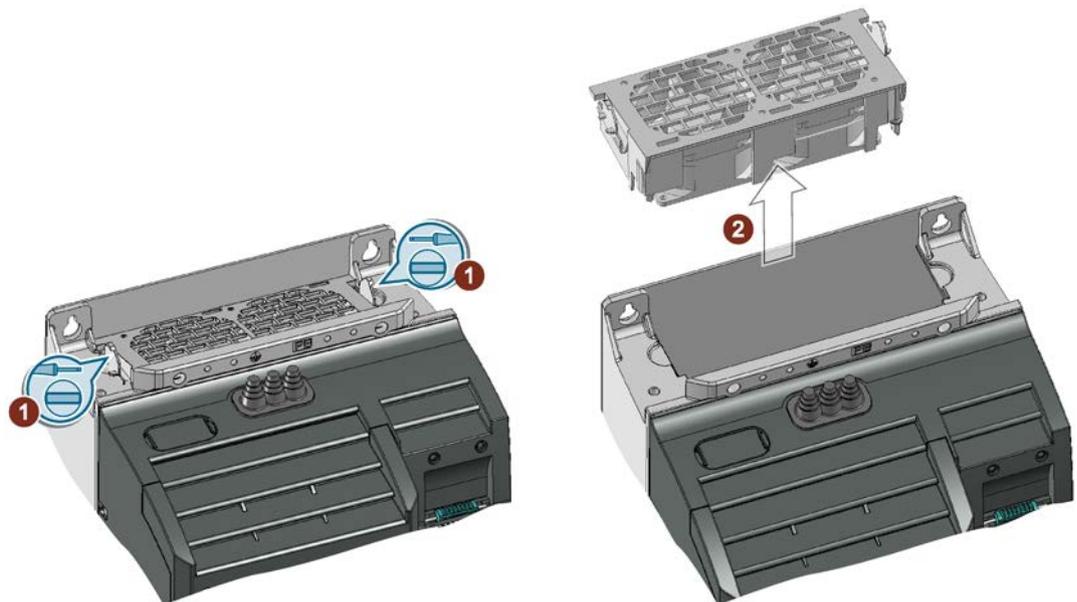


Figure 12-2 Fan replacement PM240-2, frame sizes FSD ... FSF

Proceed as follows to replace a fan module:

1. Switch-off the Power Module and wait 5 minutes until the DC link capacitors have been discharged.
2. Press the lateral lugs towards the center of the device and withdraw the fan module vertically upwards out of the device.
3. Install the new fan module in the inverse sequence.

Frame size FSG

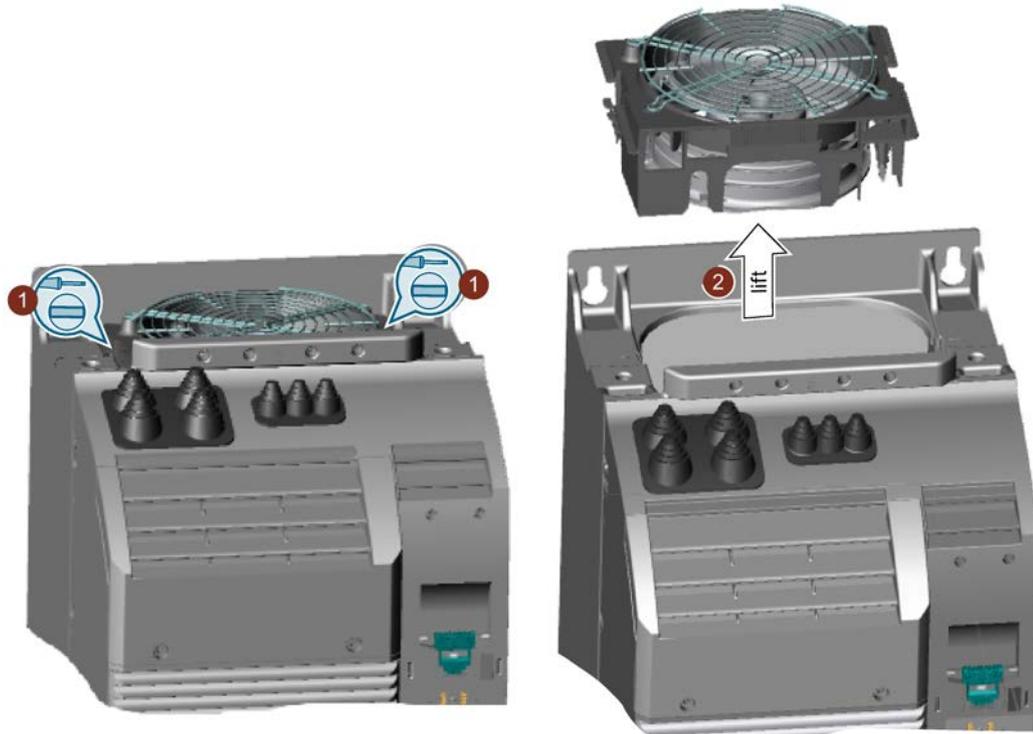


Figure 12-3 Fan replacement PM240-2, frame size FSG

Proceed as follows to replace a fan module:

1. Switch-off the Power Module and wait 5 minutes until the DC link capacitors have been discharged.
2. Remove the fan module from the Power Module in steps ① and ② as shown in the diagram. Use a screwdriver.
3. Install the new fan module in the inverse sequence.

12.3 Service and maintenance for Chassis format components

Maintenance is intended to ensure that the equipment remains in the specified condition. Dirt and contamination must be removed regularly and parts subject to wear replaced.

The following points must generally be observed.

Dust deposits

Dust deposits inside the device must be removed at regular intervals (or at least once a year) by qualified personnel in line with the relevant safety regulations. The device must be cleaned using a brush and vacuum cleaner. Areas that cannot be easily reached must be cleaned with dry compressed air (max. 100 kPa).

Ventilation

The ventilation openings in the devices must never be obstructed. The fans must be checked to make sure that they are functioning correctly.

Cable and screw terminals

Cable and screw terminals must be checked regularly to ensure that they are secure in position, and if necessary, retightened. Cabling must be checked for defects. Defective parts must be replaced immediately.

Note

The actual intervals at which maintenance procedures are to be performed depend on the installation conditions (cabinet environment) and the operating conditions.

Siemens offers its customers support in the form of a service contract. For further details, contact your regional office or sales office.

12.3.1 Maintenance

Servicing involves activities and procedures for maintaining and restoring the operating condition of the devices.

Required tools

The following tools are required for replacing components:

- Standard set of tools with screwdrivers, screw wrenches, socket wrenches, etc.
- Torque wrench, 1.5 Nm to 100 Nm (13.3 ... 885 lbf in)
- 600 mm extension for socket wrenches

Tightening torques for screw connections

The following tightening torques apply when tightening current-conducting connections (DC link connections, motor connections, busbars, lugs) and other connections (ground connections, protective conductor connections, steel threaded connections).

Table 12- 1 Tightening torques for screw connections

Thread	Ground connections, protective conductor connections, steel threaded connections	Aluminum threaded connections, plastic, busbars, lugs
M3	1.3 Nm (11.5 lbf in)	0.8 Nm (7.1 lbf in)
M4	3 Nm (26.6 lbf in)	1.8 Nm (15.9 lbf in)
M5	6 Nm (53.1 lbf in)	3 Nm (26.6 lbf in)
M6	10 Nm (88.5 lbf in)	6 Nm (53.1 lbf in)
M8	25 Nm (221 lbf in)	13 Nm (115 lbf in)
M10	50 Nm (443 lbf in)	25 Nm (221 lbf in)
M12	88 Nm (779 lbf in)	50 Nm (443 lbf in)

12.3.2 Installation equipment

Description

The installation equipment is used to install and remove the power blocks for Power Modules in the chassis format.

It is placed in front of the module and attached to it. The telescopic guide support allows the withdrawable device to be adjusted according to the height at which the power blocks are installed. Once the mechanical and electrical connections have been released, the power block can be removed from the module. Whereby the power block is guided and supported by the guide rails on the withdrawable devices.



Figure 12-4 Mounting equipment

Article number of the mounting equipment: 6SL3766-1FA00-0AA0

12.3.3 Replacing components

12.3.3.1 Replacing the Powerblock, Power Module, frame size FX

Replacing the powerblock

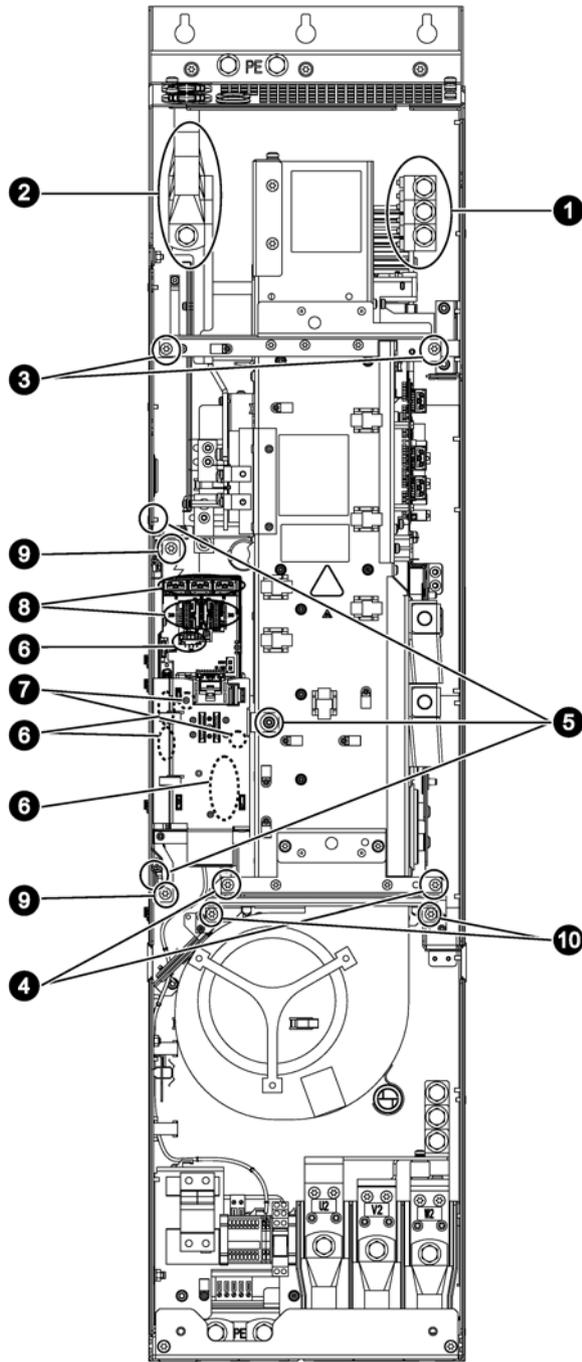


Figure 12-5 Replacing the Powerblock, Power Module, frame size FX

Preparatory steps

- Disconnect the drive line-up.
- Make sure the power block is accessible.
- Remove the front cover.

Removal

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Unscrew the connection of the motor outgoing feeder (3 screws).
2. Unscrew the connection for the infeed (3 screws).
3. Remove the retaining screws at the top (2 screws).
4. Remove the retaining screws at the bottom (2 screws).
5. Remove the retaining nuts of the supporting plate for the Control Unit and remove the supporting plate (3 nuts).
6. Remove DRIVE-CLiQ cables and connections at -X41/-X42/-X46 (6 connectors).
The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
7. Take out the retaining screws for the IPD card (2 screws) and remove the IPD card from -X45 connector on the Control Interface Module.
8. Disconnect the plug-in connections of the fiber-optic cables and the signal cables (5 connectors).
9. Remove the retaining screws of the withdrawable electronic unit (2 screws) and carefully remove the electronic unit.
When removing the plug-in module, 5 additional connectors (2 at the top, 3 at the bottom) must be removed one after the other.
10. Unscrew the 2 retaining screws for the fan and attach the mounting device for the power block at this position.

You can now remove the Powerblock.

Note

The power block weighs approx. 65 kg.

NOTICE

Device damage as a result of damaged signal cables when removing

Signal cables can be damaged when the power block is removed. This can cause the device to fail.

- When removing the power block, ensure that you do not damage any signal cables.

Installation

To reinstall, perform the above steps in reverse order.

Note

Connecting fiber-optic cables

The fiber-optic cable plugs must be re-inserted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

Note

Connection clip to the interference-suppression capacitor

The connection clip to the interference-suppression capacitor is mounted on the spare power block together with a yellow warning label.

Please note the information in Chapter "Electrical connection" of the corresponding device.

12.3.3.2 Replacing the Powerblock, Power Module, frame size GX

Replacing the powerblock

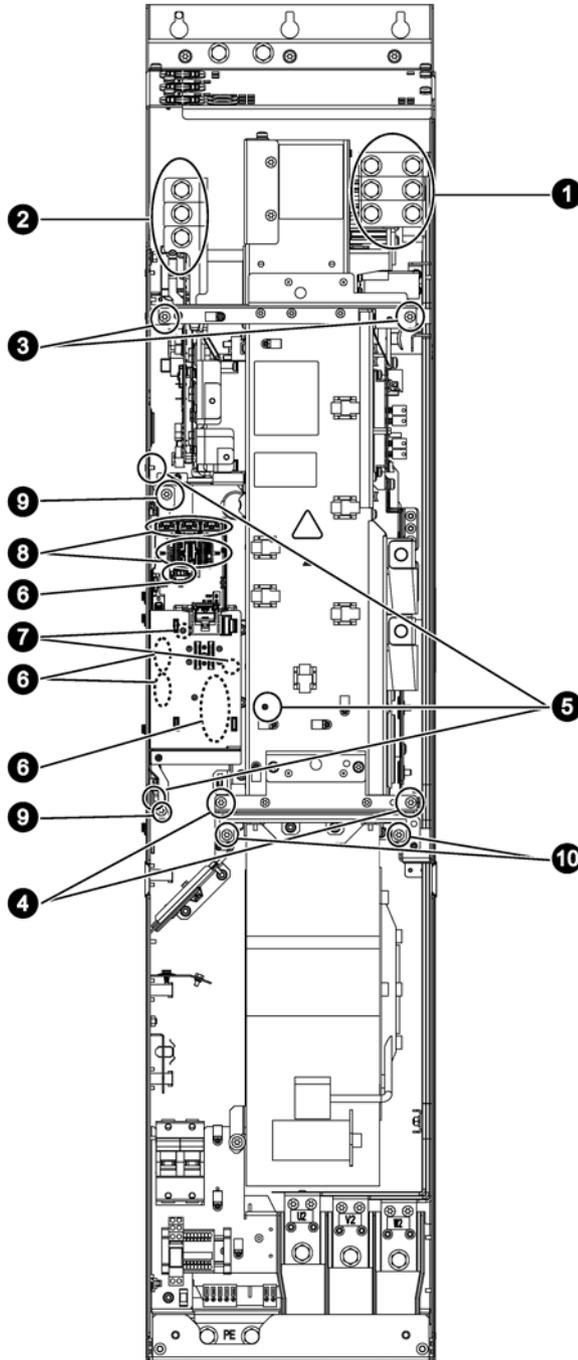


Figure 12-6 Replacing the Powerblock, Power Module, frame size GX

Preparatory steps

- Disconnect the drive line-up.
- Make sure the power block is accessible.
- Remove the front cover.

Removal

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Unscrew the connection of the motor outgoing feeder (6 screws).
2. Unscrew the connection for the infeed (3 screws).
3. Remove the retaining screws at the top (2 screws).
4. Remove the retaining screws at the bottom (2 screws).
5. Remove the retaining nuts of the supporting plate for the Control Unit and remove the supporting plate (3 nuts).
6. Remove DRIVE-CLiQ cables and connections at –X41/–X42/–X46 (6 connectors).
The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
7. Take out the retaining screws for the IPD card (2 screws) and remove the IPD card from –X45 connector on the Control Interface Module.
8. Disconnect the plug-in connections of the fiber-optic cables and signal cables (5 connectors).
9. Remove the retaining screws of the withdrawable electronic unit (2 screws) and carefully remove the electronic unit.
When removing the plug-in module, 5 additional connectors (2 at the top, 3 at the bottom) must be removed one after the other.
10. Unscrew 2 retaining screws for the fan and attach the mounting device for the power block at this position.

You can now remove the Powerblock.

Note

The power block weighs approx. 96 kg

NOTICE**Device damage as a result of damaged signal cables when removing**

Signal cables can be damaged when the power block is removed. This can cause the device to fail.

- When removing the power block, ensure that you do not damage any signal cables.

Installation

To reinstall, perform the above steps in reverse order.

Note

Connecting fiber-optic cables

The fiber-optic cable plugs must be re-inserted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

Note

Connection clip to the interference-suppression capacitor

The connection clip to the interference-suppression capacitor is mounted on the spare power block together with a yellow warning label.

Please note the information in the chapter "Electrical connection" of the corresponding device.

12.3.3.3 Replacing the Control Interface Module, Power Module, frame size FX

Replacing the Control Interface Module

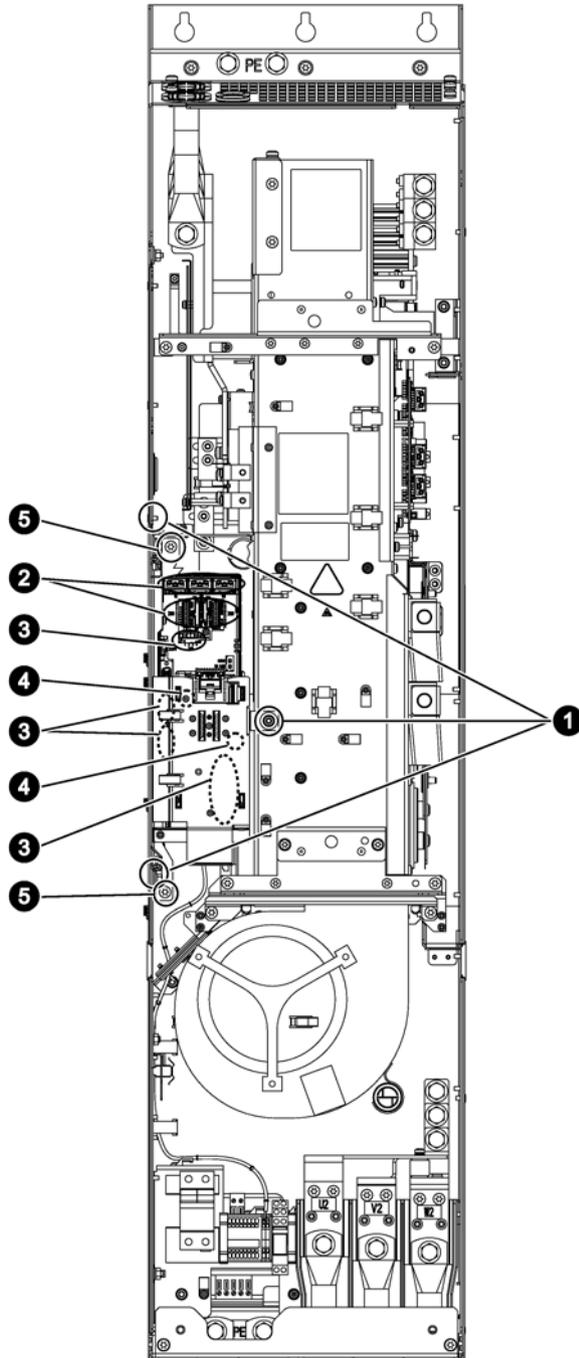


Figure 12-7 Replacing the Control Interface Module, Power Module, frame size FX

Preparatory steps

- Disconnect the drive line-up.
- Make sure the power block is accessible.
- Remove the front cover.

Removal

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Remove the retaining nuts of the supporting plate for the Control Unit and remove the supporting plate (3 nuts).
2. Disconnect the plug-in connections of the fiber-optic cables and signal cables (5 connectors).
3. Remove DRIVE-CLiQ cables and connections at -X41/-X42/-X46 (6 connectors). The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
4. Take out the retaining screws for the IPD card (2 screws) and remove the IPD card from -X45 connector on the Control Interface Module.
5. Remove the retaining screws for the Control Interface Module (2 screws).

When removing the Control Interface Module, you must disconnect 5 additional connectors one after the other (2 at the top, 3 at the bottom).

NOTICE

Device damage as a result of damaged signal cables when removing

Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure.

- When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Installation

To reinstall, perform the above steps in reverse order.

Note

Connecting fiber-optic cables

The fiber-optic cable plugs must be re-inserted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

12.3.3.4 Replacing the Control Interface Module, Power Module, frame size GX

Replacing the Control Interface Module

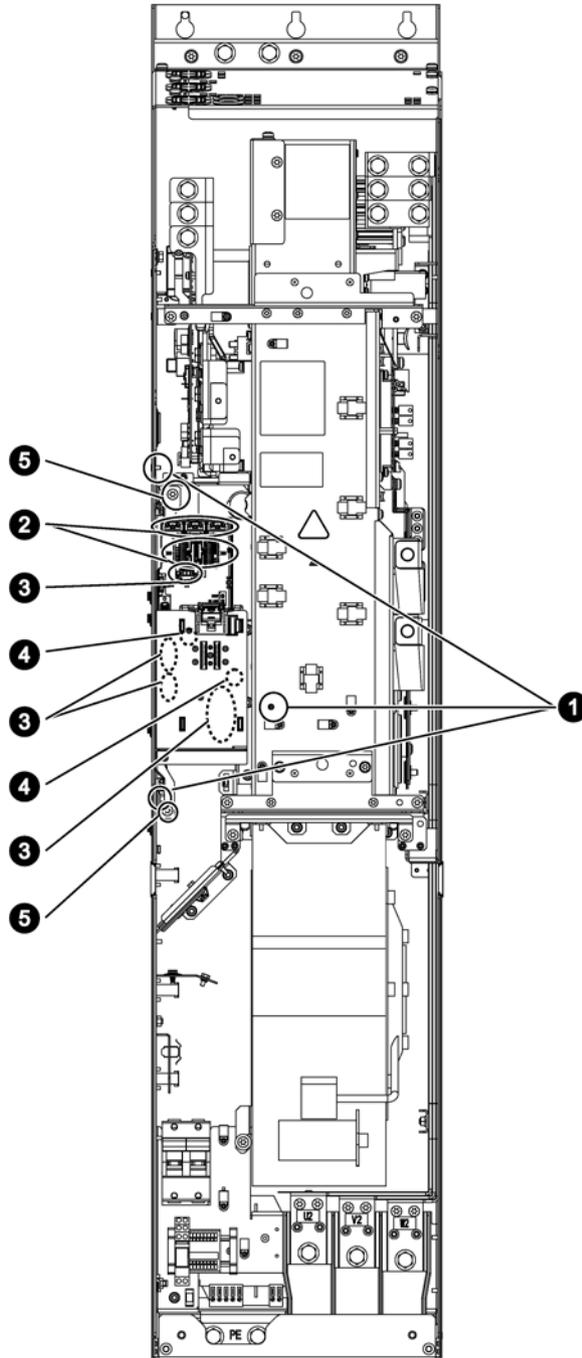


Figure 12-8 Replacing the Control Interface Module, Power Module, frame size GX

Preparatory steps

- Disconnect the drive line-up.
- Make sure the power block is accessible.
- Remove the front cover.

Removal

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Remove the retaining nuts of the supporting plate for the Control Unit and remove the supporting plate (3 nuts).
2. Disconnect the plug-in connections of the fiber-optic cables and signal cables (5 connectors).
3. Remove DRIVE-CLiQ cables and connections at -X41/-X42/-X46 (6 connectors). The DRIVE-CLiQ cables should be marked to ensure that they are subsequently correctly inserted.
4. Take out the retaining screws for the IPD card (2 screws) and remove the IPD card from -X45 connector on the Control Interface Module.
5. Remove the retaining screws for the Control Interface Module (2 screws).

When removing the Control Interface Module, you must disconnect 5 additional connectors one after the other (2 at the top, 3 at the bottom).

NOTICE

Device damage as a result of damaged signal cables when removing

Signal cables can be damaged when withdrawing the Control Interface Module, which can result in a device failure.

- When withdrawing the Control Interface Module, ensure that you do not damage any signal cables.

Installation

To reinstall, perform the above steps in reverse order.

Note

Connecting fiber-optic cables

The fiber-optic cable plugs must be re-inserted at their original slot. Fiber-optic cables and sockets are accordingly labeled for correct assignment (U11, U21, U31).

12.3.3.5 Replacing the fan, Power Module, frame size FX

Replacing the fan

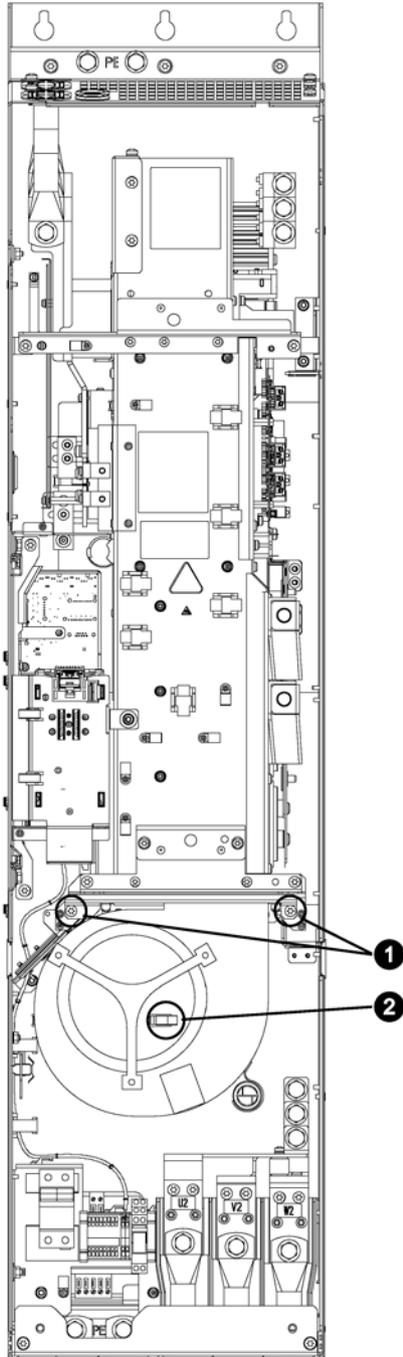


Figure 12-9 Replacing the fan, Power Module, frame size FX

Description

The average service life of the device fans is 50000 hours. In practice, however, the service life depends on other variables, e.g. ambient temperature, degree of cabinet protection, etc. and, therefore, may deviate from this value in individual cases.

The fans must be replaced in good time to ensure that the device is available.

Preparatory steps

- Disconnect the drive line-up.
- Provide unobstructed access.
- Remove the front cover.

Removal

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Remove the retaining screws for the fan (2 screws).
2. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

NOTICE
Device damage as a result of damaged signal cables when removing
Signal cables can become damaged when the fan is removed. This can cause the device to fail.
<ul style="list-style-type: none">• When removing the fan, ensure that you do not damage any signal cables.

Installation

To reinstall, perform the above steps in reverse order.

Note

Reset the operating hours counter

Following fan replacement, the operating hours counter of the fan should be reset via p0251 = 0.

12.3.3.6 Replacing the fan, Power Module, frame size GX

Replacing the fan

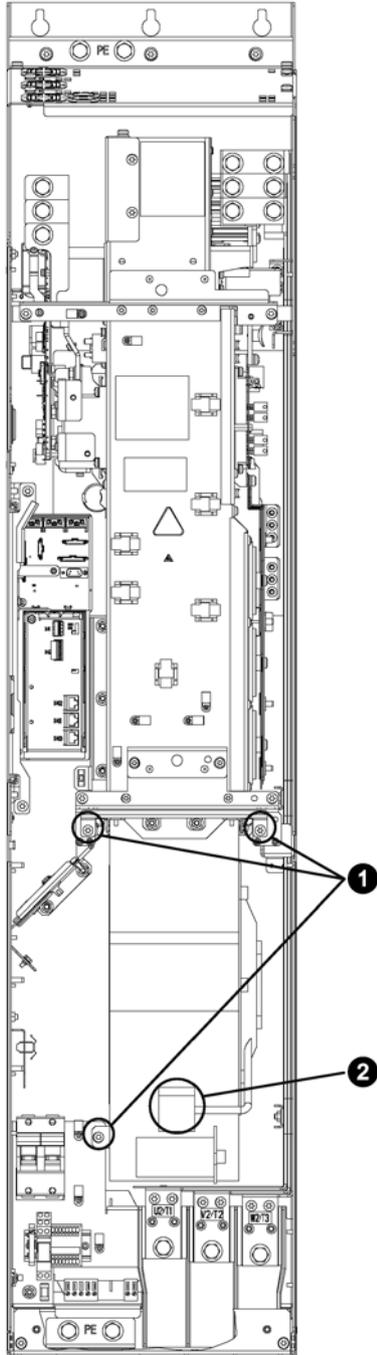


Figure 12-10 Replacing the fan, Power Module, frame size GX

Description

The average service life of the device fans is 50000 hours. In practice, however, the service life depends on other variables, e.g. ambient temperature, degree of cabinet protection, etc. and, therefore, may deviate from this value in individual cases.

The fans must be replaced in good time to ensure that the device is available.

Preparatory steps

- Disconnect the drive line-up.
- Provide unobstructed access.
- Remove the front cover.

Removal

The steps for the removal procedure are numbered in accordance with the previous diagram.

1. Remove the retaining screws for the fan (3 screws).
2. Disconnect the supply cables (1 x "L", 1 x "N").

You can now carefully remove the fan.

NOTICE
Device damage as a result of damaged signal cables when removing
Signal cables can become damaged when the fan is removed. This can cause the device to fail.
<ul style="list-style-type: none">• When removing the fan, ensure that you do not damage any signal cables.

Installation

To reinstall, perform the above steps in reverse order.

Note

Reset the operating hours counter

Following fan replacement, the operating hours counter of the fan should be reset via p0251 = 0.

12.4 Forming the DC link capacitors

NOTICE
<p>Damage in the case of long storage periods</p> <p>After being in storage for more than two years, the components may suffer damage when switched on.</p> <ul style="list-style-type: none"> • Form the DC link capacitors of the Power Module again.

If the cabinet is commissioned within two years of its date of manufacture, the DC link capacitors do not need to be reformed. The date of manufacture can be taken from the serial number on the rating plate.

Note

The storage period starts from the date of manufacture and not from the date on which the equipment was shipped.

Date of manufacture

The date of manufacture can be determined from the following assignment to the serial number (e.g. T-**E9**2067000015 for 2014, September):

Table 12- 2 Production year and month

Character	Year of manufacture	Character	Month of manufacture
A	2010	1 to 9	January to September
B	2011	O	October
C	2012	N	November
D	2013	D	December
E	2014		
F	2015		
H	2016		
J	2017		
K	2018		
L	2019		
M	2020		
N	2021		
O	2022		

The serial number is found on the rating plate.

When DC link capacitors are formed, a defined voltage is connected to them and a defined current flows so that the appropriate capacitor characteristics are restored for them to be used as DC link capacitors.

Forming circuit

The forming circuit can be built using incandescent lamps or, alternatively, resistors.

Components required for reforming outside the drive line-up

- 1 fuse switch, triple 400 V / 10 A or double 230 V / 10 A
- Cable 1.5 mm² (AWG 16)
- 3 incandescent lamps 230 V / 100 W for a line voltage of 3-phase 380 - 480 V AC. Alternatively, use 3 resistors of 1 kΩ / 100 W each (e.g. GWK150J1001KLX000 from Vishay) instead of the incandescent lamps.
- 2 incandescent lamps 230 V / 100 W for a line voltage of 1-phase 200 - 240 V AC. Alternatively, use 2 resistors of 1 kΩ / 100 W each (e.g. GWK150J1001KLX000 from Vishay) instead of the incandescent lamps.
- Sundry accessories, such as lamp socket, etc.

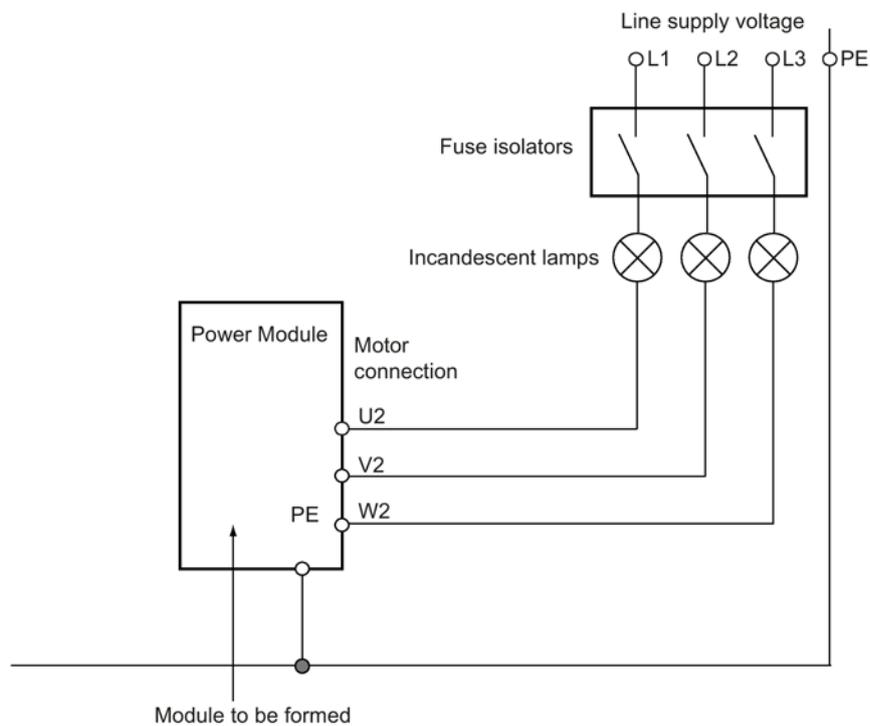


Figure 12-11 Forming circuit for 3-phase AC Power Modules with incandescent lamps

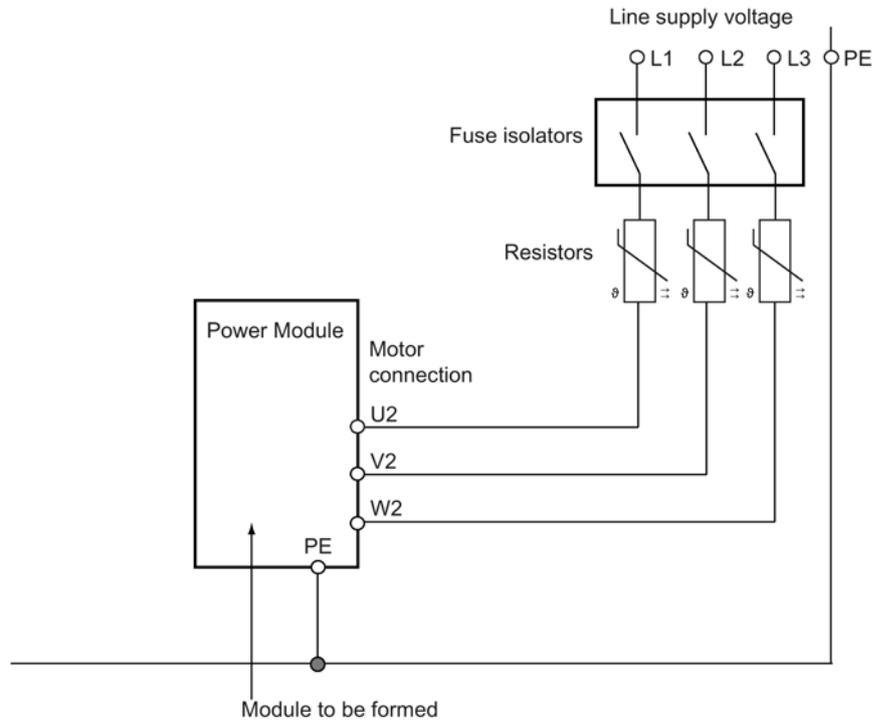


Figure 12-12 Forming circuit for 3-phase AC Power Modules with resistors

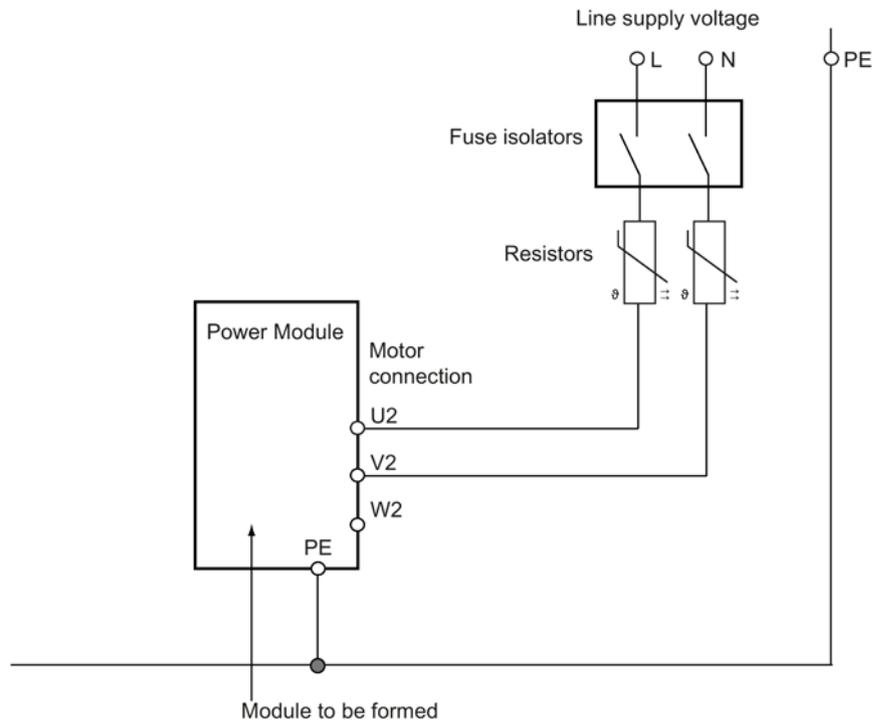


Figure 12-13 Forming circuit for 1-phase AC Power Modules with resistors

Procedure

- Make sure that the device **does not** receive a power-on command (e.g. from the keyboard or terminal block).
- Connect the forming circuit.
- While forming, the incandescent lamps must become less bright or go completely dark. If the incandescent lamps continue to be brightly lit, a fault has occurred in the drive unit or in the wiring.
- For forming using resistors, the module must remain in the circuit for approx. 1h. The resistors will become very hot if there is a fault in the unit (surface temperature > 80 °C).

12.5

Recycling and disposal



For environmentally friendly recycling and disposal of your old device, please contact a company certified for the disposal of electrical and electronic waste and dispose of the device in accordance with the regulations in your country.

Appendix

A.1 List of abbreviations

Note

The following list of abbreviations includes all abbreviations and their meanings used in the entire SINAMICS family of drives.

A

Abbreviation	Derivation of abbreviation	Meaning
A...	Alarm	Warning
AC	Alternating Current	Alternating current
ADC	Analog Digital Converter	Analog digital converter
AI	Analog Input	Analog input
AIM	Active Interface Module	Active Interface Module
ALM	Active Line Module	Active Line Module
AO	Analog Output	Analog output
AOP	Advanced Operator Panel	Advanced Operator Panel
APC	Advanced Positioning Control	Advanced Positioning Control
AR	Automatic Restart	Automatic restart
ASC	Armature Short-Circuit	Armature short-circuit
ASCII	American Standard Code for Information Interchange	American coding standard for the exchange of information
AS-i	AS-Interface (Actuator Sensor Interface)	AS-Interface (open bus system in automation technology)
ASM	Asynchronmotor	Induction motor
AVS	Active Vibration Suppression	Active load vibration damping
AWG	American Wire Gauge	American Wire Gauge (Standard for cross-sections of cables)

B

Abbreviation	Derivation of abbreviation	Meaning
BB	Betriebsbedingung	Operation condition
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	BG Institute for Occupational Safety and Health

A.1 List of abbreviations

Abbreviation	Derivation of abbreviation	Meaning
BICO	Binector Connector Technology	Binector connector technology
BLM	Basic Line Module	Basic Line Module
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic operator panel

C

Abbreviation	Derivation of abbreviation	Meaning
C	Capacitance	Capacitance
C...	-	Safety message
CAN	Controller Area Network	Serial bus system
CBC	Communication Board CAN	Communication Board CAN
CBE	Communication Board Ethernet	PROFINET communication module (Ethernet)
CD	Compact Disc	Compact disc
CDS	Command Data Set	Command data set
CF Card	CompactFlash Card	CompactFlash card
CI	Connector Input	Connector input
CLC	Clearance Control	Clearance control
CNC	Computerized Numerical Control	Computer-supported numerical control
CO	Connector Output	Connector output
CO/BO	Connector Output/Binector Output	Connector/binector output
COB-ID	CAN Object-Identification	CAN Object Identification
CoL	Certificate of License	Certificate of License
COM	Common contact of a change-over relay	Center contact of a change-over contact
COMM	Commissioning	Commissioning
CP	Communication Processor	Communications processor
CPU	Central Processing Unit	Central processing unit
CRC	Cyclic Redundancy Check	Cyclic redundancy check
CSM	Control Supply Module	Control Supply Module
CU	Control Unit	Control Unit
CUA	Control Unit Adapter	Control Unit Adapter
CUD	Control Unit DC	Control Unit DC

D

Abbreviation	Derivation of abbreviation	Meaning
DAC	Digital Analog Converter	Digital analog converter
DC	Direct Current	Direct current
DCB	Drive Control Block	Drive Control Block
DCBRK	DC Brake	DC braking
DCC	Drive Control Chart	Drive Control Chart

Abbreviation	Derivation of abbreviation	Meaning
DCN	Direct Current Negative	Direct current negative
DCP	Direct Current Positive	Direct current positive
DDC	Dynamic Drive Control	Dynamic Drive Control
DDS	Drive Data Set	Drive Data Set
DHCP	Dynamic Host Configuration Protocol	Dynamic Host Configuration Protocol (Communication protocol)
DI	Digital Input	Digital input
DI/DO	Digital Input/Digital Output	Digital input/output, bidirectional
DIN	Deutsches Institut für Normung	Deutsches Institut für Normung (German Institute for Standardization)
DMC	DRIVE-CLiQ Hub Module Cabinet	DRIVE-CLiQ Hub Module Cabinet
DME	DRIVE-CLiQ Hub Module External	DRIVE-CLiQ Hub Module External
DMM	Double Motor Module	Double Motor Module
DO	Digital Output	Digital output
DO	Drive Object	Drive object
DP	Decentralized Peripherals	Distributed I/O
DPRAM	Dual Ported Random Access Memory	Dual-Port Random Access Memory
DQ	DRIVE-CLiQ	DRIVE-CLiQ
DRAM	Dynamic Random Access Memory	Dynamic Random Access Memory
DRIVE-CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
DSC	Dynamic Servo Control	Dynamic Servo Control
DSM	Doppelsubmodul	Double submodule
DTC	Digital Time Clock	Timer

E

Abbreviation	Derivation of abbreviation	Meaning
EASC	External Armature Short-Circuit	External armature short-circuit
EDS	Encoder Data Set	Encoder data set
EEPROM	Electrically Erasable Programmable Read-Only Memory	Electrically Erasable Programmable Read-Only Memory
EGB	Elektrostatisch gefährdete Baugruppen	Electrostatic sensitive devices
EIP	EtherNet/IP	EtherNet Industrial Protocol (real-time Ethernet)
ELCB	Earth Leakage Circuit Breaker	Residual current operated circuit breaker
ELP	Earth Leakage Protection	Ground-fault monitoring
EMC	Electromagnetic Compatibility	Electromagnetic compatibility
EMF	Electromotive Force	Electromotive force
EMK	Elektromotorische Kraft	Electromotive force
EMV	Elektromagnetische Verträglichkeit	Electromagnetic compatibility
EN	Europäische Norm	European standard
EnDat	Encoder-Data-Interface	Encoder interface
EP	Enable Pulses	Pulse enable

A.1 List of abbreviations

Abbreviation	Derivation of abbreviation	Meaning
EPOS	Einfachpositionierer	Basic positioner
ES	Engineering System	Engineering system
ESB	Ersatzschaltbild	Equivalent circuit diagram
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ESM	Essential Service Mode	Essential service mode
ESR	Extended Stop and Retract	Extended stop and retract

F

Abbreviation	Derivation of abbreviation	Meaning
F...	Fault	Fault
FAQ	Frequently Asked Questions	Frequently Asked Questions
FBLOCKS	Free Blocks	Free function blocks
FCC	Function Control Chart	Function control chart
FCC	Flux Current Control	Flux current control
FD	Function Diagram	Function diagram
F-DI	Failsafe Digital Input	Fail-safe digital input
F-DO	Failsafe Digital Output	Fail-safe digital output
FEPROM	Flash-EPROM	Non-volatile write and read memory
FG	Function Generator	Function generator
FI	-	Fault current
FOC	Fiber-Optic Cable	Fiber-optic cable
FP	Funktionsplan	Function diagram
FPGA	Field Programmable Gate Array	Field Programmable Gate Array
F-PLC	Fail-safe PLC	Fail-safe PLC
FW	Firmware	Firmware

G

Abbreviation	Derivation of abbreviation	Meaning
GB	Gigabyte	Gigabyte
GC	Global Control	Global control telegram (broadcast telegram)
GND	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as M)
GSD	Gerätstammdatei	Generic Station Description: Describes the features of a PROFIBUS slave
GSV	Gate Supply Voltage	Gate supply voltage
GUID	Globally Unique Identifier	Globally Unique Identifier

H

Abbreviation	Derivation of abbreviation	Meaning
HF	High frequency	High frequency
HFD	Hochfrequenzdrossel	Radio frequency reactor
HLA	Hydraulic Linear Actuator	Hydraulic linear actuator
HLG	Hochlaufgeber	Ramp-function generator
HM	Hydraulic Module	Hydraulic Module
HMI	Human Machine Interface	Human Machine Interface
HTL	High-Threshold Logic	Logic with high interference threshold
HTTP	Hypertext Transfer Protocol	Hypertext Transfer Protocol (communication protocol)
HTTPS	Hypertext Transfer Protocol Secure	Hypertext Transfer Protocol Secure (communication protocol)
HW	Hardware	Hardware

I

Abbreviation	Derivation of abbreviation	Meaning
i. V.	In Vorbereitung	Under development: This property is currently not available
I/O	Input/Output	Input/output
I2C	Inter-Integrated Circuit	Internal serial data bus
IASC	Internal Armature Short-Circuit	Internal armature short-circuit
IBN	Inbetriebnahme	Commissioning
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Insulated gate bipolar transistor
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode
IL	Impulslöschung	Pulse suppression
IP	Internet Protocol	Internet Protocol
IPO	Interpolator	Interpolator
ISO	Internationale Organisation für Normung	International Standards Organization
IT	Isolé Terre	Non-grounded three-phase line supply
IVP	Internal Voltage Protection	Internal voltage protection

J

Abbreviation	Derivation of abbreviation	Meaning
JOG	Jogging	Jogging

K

Abbreviation	Derivation of abbreviation	Meaning
KDV	Kreuzweiser Datenvergleich	Data cross-check
KHP	Know-how protection	Know-how protection
KIP	Kinetische Pufferung	Kinetic buffering
Kp	-	Proportional gain
KTY84-130	-	Temperature sensor

L

Abbreviation	Derivation of abbreviation	Meaning
L		
L	-	Symbol for inductance
LED	Light Emitting Diode	Light emitting diode
LIN	Linearmotor	Linear motor
LR	Lageregler	Position controller
LSB	Least Significant Bit	Least significant bit
LSC	Line-Side Converter	Line-side converter
LSS	Line-Side Switch	Line-side switch
LU	Length Unit	Length unit
LWL	Lichtwellenleiter	Fiber-optic cable

M

Abbreviation	Derivation of abbreviation	Meaning
M	-	Symbol for torque
M	Masse	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as GND)
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDI	Manual Data Input	Manual data input
MDS	Motor Data Set	Motor data set
MLFB	Maschinenlesbare Fabrikatebezeichnung	Machine-readable product code
MM	Motor Module	Motor Module
MMC	Man-Machine Communication	Man-machine communication
MMC	Micro Memory Card	Micro memory card
MRCD	Modular Residual Current protection Device	Modular Residual Current protection Device
MSB	Most Significant Bit	Most significant bit
MSC	Motor-Side Converter	Motor-side converter
MSCY_C1	Master Slave Cycle Class 1	Cyclic communication between master (class 1) and slave

Abbreviation	Derivation of abbreviation	Meaning
MSR	Motorstromrichter	Motor-side converter
MT	Messtaster	Probe

N

Abbreviation	Derivation of abbreviation	Meaning
N. C.	Not Connected	Not connected
N...	No Report	No report or internal message
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	Standardization association for measurement and control in chemical industries
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization association in USA (United States of America)
NM	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contact
NSR	Netzstromrichter	Line-side converter
NTP	Network Time Protocol	Standard for synchronization of the time of day
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory

O

Abbreviation	Derivation of abbreviation	Meaning
OA	Open Architecture	Software component which provides additional functions for the SINAMICS drive system
OAIF	Open Architecture Interface	Version of the SINAMICS firmware as of which the OA application can be used
OASP	Open Architecture Support Package	Expands the commissioning tool by the corresponding OA application
OC	Operating Condition	Operation condition
OCC	One Cable Connection	One-cable technology
OEM	Original Equipment Manufacturer	Original equipment manufacturer
OLP	Optical Link Plug	Bus connector for fiber-optic cable
OMI	Option Module Interface	Option Module Interface

P

Abbreviation	Derivation of abbreviation	Meaning
p...	-	Adjustable parameters
P1	Processor 1	CPU 1
P2	Processor 2	CPU 2
PB	PROFIBUS	PROFIBUS

Appendix

A.1 List of abbreviations

Abbreviation	Derivation of abbreviation	Meaning
PcCtrl	PC Control	Master control
PD	PROFIdrive	PROFIdrive
PDC	Precision Drive Control	Precision Drive Control
PDS	Power unit Data Set	Power unit data set
PDS	Power Drive System	Drive system
PE	Protective Earth	Protective ground
PELV	Protective Extra Low Voltage	Safety extra-low voltage
PFH	Probability of dangerous failure per hour	Probability of dangerous failure per hour
PG	Programmiergerät	Programming device
PI	Proportional Integral	Proportional integral
PID	Proportional Integral Differential	Proportional integral differential
PLC	Programmable Logical Controller	Programmable logic controller
PLL	Phase-Locked Loop	Phase-locked loop
PM	Power Module	Power Module
PMI	Power Module Interface	Power Module Interface
PMSM	Permanent-magnet synchronous motor	Permanent-magnet synchronous motor
PN	PROFINET	PROFINET
PNO	PROFIBUS Nutzerorganisation	PROFIBUS user organization
PPI	Point to Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
PT1000	-	Temperature sensor
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point To Point	Point-to-point
PWM	Pulse Width Modulation	Pulse width modulation
PZD	Prozessdaten	Process data

Q

Abbreviation	Derivation of abbreviation	Meaning
No entries		

R

Abbreviation	Derivation of abbreviation	Meaning
r...	-	Display parameters (read-only)
RAM	Random Access Memory	Memory for reading and writing
RCCB	Residual Current Circuit Breaker	Residual current operated circuit breaker
RCD	Residual Current Device	Residual current device

Abbreviation	Derivation of abbreviation	Meaning
RCM	Residual Current Monitor	Residual current monitor
REL	Reluctance motor textile	Reluctance motor textile
RESM	Reluctance synchronous motor	Synchronous reluctance motor
RFG	Ramp-Function Generator	Ramp-function generator
RJ45	Registered Jack 45	Term for an 8-pin socket system for data transmission with shielded or non-shielded multi-wire copper cables
RKA	Rückkühlanlage	Cooling unit
RLM	Renewable Line Module	Renewable Line Module
RO	Read Only	Read only
ROM	Read-Only Memory	Read-only memory
RPDO	Receive Process Data Object	Receive Process Data Object
RS232	Recommended Standard 232	Interface standard for cable-connected serial data transmission between a sender and receiver (also known as EIA232)
RS485	Recommended Standard 485	Interface standard for a cable-connected differential, parallel, and/or serial bus system (data transmission between a number of senders and receivers, also known as EIA485)
RTC	Real Time Clock	Real-time clock
RZA	Raumzeigerapproximation	Space-vector approximation

S

Abbreviation	Derivation of abbreviation	Meaning
S1	-	Continuous operation
S3	-	Intermittent duty
SAM	Safe Acceleration Monitor	Safe acceleration monitoring
SBC	Safe Brake Control	Safe brake control
SBH	Sicherer Betriebshalt	Safe operating stop
SBR	Safe Brake Ramp	Safe brake ramp monitoring
SBT	Safe Brake Test	Safe brake test
SCA	Safe Cam	Safe cam
SCC	Safety Control Channel	Safety Control Channel
SCSE	Single Channel Safety Encoder	Single-channel safety encoder
SD Card	SecureDigital Card	Secure digital memory card
SDC	Standard Drive Control	Standard Drive Control
SDI	Safe Direction	Safe motion direction
SE	Sicherer Software-Endschalter	Safe software limit switch
SESM	Separately-excited synchronous motor	Separately excited synchronous motor
SG	Sicher reduzierte Geschwindigkeit	Safely limited speed
SGA	Sicherheitsgerichteter Ausgang	Safety-related output
SGE	Sicherheitsgerichteter Eingang	Safety-related input

A.1 List of abbreviations

Abbreviation	Derivation of abbreviation	Meaning
SH	Sicherer Halt	Safe stop
SI	Safety Integrated	Safety Integrated
SIC	Safety Info Channel	Safety Info Channel
SIL	Safety Integrity Level	Safety Integrity Level
SITOP	-	Siemens power supply system
SLA	Safely-Limited Acceleration	Safely limited acceleration
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely Limited Position
SLS	Safely-Limited Speed	Safely limited speed
SLVC	Sensorless Vector Control	Sensorless vector control
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SMI	SINAMICS Sensor Module Integrated	SINAMICS Sensor Module Integrated
SMM	Single Motor Module	Single Motor Module
SN	Sicherer Software-Nocken	Safe software cam
SOS	Safe Operating Stop	Safe operating stop
SP	Service Pack	Service pack
SP	Safe Position	Safe position
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial peripheral interface
SPS	Speicherprogrammierbare Steuerung	Programmable logic controller
SS1	Safe Stop 1	Safe Stop 1 (time-monitored, ramp-monitored)
SS1E	Safe Stop 1 External	Safe Stop 1 with external stop
SS2	Safe Stop 2	Safe Stop 2
SS2E	Safe Stop 2 External	Safe Stop 2 with external stop
SSI	Synchronous Serial Interface	Synchronous serial interface
SSL	Secure Sockets Layer	Encryption protocol for secure data transfer (new TLS)
SSM	Safe Speed Monitor	Safe feedback from speed monitor
SSP	SINAMICS Support Package	SINAMICS support package
STO	Safe Torque Off	Safe torque off
STW	Steuerwort	Control word

T

Abbreviation	Derivation of abbreviation	Meaning
TB	Terminal Board	Terminal Board
TEC	Technology Extension	Software component which is installed as an additional technology package and which expands the functionality of SINAMICS (previously OA application)
TIA	Totally Integrated Automation	Totally Integrated Automation

Abbreviation	Derivation of abbreviation	Meaning
TLS	Transport Layer Security	Encryption protocol for secure data transfer (previously SSL)
TM	Terminal Module	Terminal Module
TN	Terre Neutre	Grounded three-phase line supply
Tn	-	Integral time
TPDO	Transmit Process Data Object	Transmit Process Data Object
TSN	Time-Sensitive Networking	Time-Sensitive Networking
TT	Terre Terre	Grounded three-phase line supply
TTL	Transistor-Transistor-Logic	Transistor-transistor logic
Tv	-	Rate time

U

Abbreviation	Derivation of abbreviation	Meaning
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
USV	Unterbrechungsfreie Stromversorgung	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated

V

Abbreviation	Derivation of abbreviation	Meaning
VC	Vector Control	Vector control
Vdc	-	DC link voltage
VdcN	-	Partial DC link voltage negative
VdcP	-	Partial DC link voltage positive
VDE	Verband Deutscher Elektrotechniker	Verband Deutscher Elektrotechniker [Association of German Electrical Engineers]
VDI	Verein Deutscher Ingenieure	Verein Deutscher Ingenieure [Association of German Engineers]
VPM	Voltage Protection Module	Voltage Protection Module
Vpp	Volt peak to peak	Volt peak to peak
VSM	Voltage Sensing Module	Voltage Sensing Module

W

Abbreviation	Derivation of abbreviation	Meaning
WEA	Wiedereinschaltautomatik	Automatic restart
WZM	Werkzeugmaschine	Machine tool

X

Abbreviation	Derivation of abbreviation	Meaning
XML	Extensible Markup Language	Extensible markup language (standard language for Web publishing and document management)

Y

Abbreviation	Derivation of abbreviation	Meaning
No entries		

Z

Abbreviation	Derivation of abbreviation	Meaning
ZK	Zwischenkreis	DC link
ZM	Zero Mark	Zero mark
ZSW	Zustandswort	Status word

A.2 Documentation overview

General documentation/catalogs			
SINAMICS	G110	D 11	- Converter Chassis Units 0.12 kW up to 3 kW
	G120	D 31	- SINAMICS Converters for Single-Axis Drives and SIMOTICS Motors
	G130, G150	D 11	- Converter Chassis Units - Converter Cabinet Units
	S120, S150	D 21	- SINAMICS S120 Chassis Units and Cabinet Modules - SINAMICS S150 Converter Cabinet Units
	S120	D 21.4	- SINAMICS S120 and SIMOTICS
Manufacturer/service documentation			
SINAMICS	G110		- Getting Started - Operating Instructions - List Manuals
	G120		- Getting Started - Operating Instructions - Installation Manuals - Function Manual Safety Integrated - List Manuals
	G130		- Operating Instructions - List Manual
	G150		- Operating Instructions - List Manual
	GM150, SM120/SM150, GL150, SL150		- Operating Instructions - List Manuals
	S110		- Equipment Manual - Getting Started - Function Manual - List Manual
	S120		- Getting Started - Commissioning Manual - Function Manual Drive Functions - Function Manual Communication (from Firmware V5.2) - Function Manual Safety Integrated - Function Manual DCC - List Manual - Equipment Manual for Control Units and Additional System Components - Equipment Manual for Booksize Power Units - Equipment Manual for Booksize Power Units C/D Type - Equipment Manual for Air-Cooled Chassis Power Units - Equipment Manual for Liquid-Cooled Chassis Power Units - Equipment Manual for Water-Cooled Chassis Power Units for Common Cooling Circuits - Equipment Manual Combi - Equipment Manual for Cabinet Modules - Equipment Manual for AC Drives - SINAMICS S120M Equipment Manual Distributed Drive Technology - SINAMICS HLA System Manual Hydraulic Drive
	S150		- Operating Instructions - List Manual
	S210		- SINAMICS S210 Operating Instructions
Motors		- Configuration Manuals, Motors	
General		- Configuration Manual, EMC Installation Guideline	

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Additional information

Siemens:
www.siemens.com

Industry Online Support (Service and Support):
www.siemens.com/online-support

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www.siemens.com/industrymall

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